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THE LANDSCAPES OF INFRASTRUCTURE CORRIDORS

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by

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ABSTRACT

Although ubiquitous in the contemporary landscape, infrastructure corridors as sites for landscape design remain relatively unexplored. These corridors include pipelines, transmission lines, highways, railroads, and aqueducts. When considered, these corridors are typically conceptualized and represented as monofunctional lines that connect nodes. To question this concept of infrastructure corridors and to study the landscapes of these corridors, a method using satellite photos, GIS software, and ground surveys is proposed. The method is then tested on three case studies within Pennsylvania: Interstate 80, the Norfolk Southern Railway, and the Susquehanna-Roseland electric transmission line. With each case, after observing each corridor remotely and on the ground, a catalog of landscape sites along the corridor is developed. Further, sites adjacent to the corridors that have the potential to be leveraged into any proposed landscape intervention are also cataloged. Each catalog is then refined to a typology of sites. From this information, the specifics of each corridor are analyzed, leading to an exposition of the sites that exist within the landscape of infrastructure corridors. Factors such as connections to the surrounding landscape and the importance of movement along the corridor are also considered. Within the larger question of how existing infrastructure corridors can improve the culture, economy, and ecology of adjacent communities, this thesis proposes a refined concept of the landscapes of infrastructure corridors to improve the potential of landscapes architects to successfully intervene within existing corridors.

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Chapter One:
Rethinking the Landscapes of Infrastructure Corridors

Infrastructure corridors[1]—such as oil and gas pipelines, electric transmission lines, highways, aqueducts, and railroads—are typically discussed and represented as routes of conveyance, as linear connections between point A and point B that allow for the movement of energy, data, materials, or people.[2] These corridors are often viewed as lines that cut through an existing landscape—a point that is especially true with transportation corridors where speed distorts the physical reality of a corridor.[3] Although there are locations where these lines interact with or respond to topographic features and change course accordingly, these lines are typically viewed without thickness[4]—i.e., they are seen only as monofunctional lines transcending distance, not as landscapes containing space. In this view, an infrastructure corridor is only a vector of movement or conveyance without any opportunity for occupation: an object can be *on* a corridor or *along* a corridor but never *in* a corridor.[5]

This concept of an infrastructure corridor is partially a function of scale. At the regional scale, a corridor does connect point A to point B. At the regional scale, a line is an appropriate representation of a corridor. However, a line by itself fails to sufficiently express the landscape of an infrastructure corridor, and, at the site scale, there is a physical heterogeneity to each infrastructure corridor that both accommodates a method of conveyance (the line) and refutes the reduction of the corridor to a line (the landscape itself). This thesis seeks to rethink the landscapes of infrastructure corridors by connecting these two scales, hybridizing the conveyance of a corridor-as-line with the spatial heterogeneity of corridor-as-landscape.[6]

Theory within landscape architecture written in the past fifteen years has issued multiple calls for rethinking how infrastructure corridors are conceptualized. Much of this writing has focused on the concept of infrastructure as landscape, with the goal of viewing infrastructure as a collection of systems and processes that operate on a scale larger than a site.[7] While the idea of infrastructure as landscape helps to frame the research presented here, this thesis is a shift toward the study of the spatial specifics of individual infrastructure corridors. Rather than only outlining general trends or theorizing opportunities, my research seeks to observe the spatial structure of existing infrastructure corridors with the goal of proposing a more refined spatial conception of the landscapes of infrastructure corridors. This work is focused on specific conditions of specific sites and corridors in order to suggest more universal patterns. These specifics are addressed in three chapters with the prefix of "Situation." Only in the concluding chapter does this thesis approach the realm of theory, with an attempt to note observations made during the study of specific corridors and then to connect these observations to ideas and concepts that can be applied by designers to the landscape of any existing infrastructure corridor.

The purpose of developing a new spatial concept for the landscapes of infrastructure corridors is to recognize the opportunities that infrastructure corridors present for landscape design. Seeing infrastructure corridors as a line suggests only a limited catalog of potential interventions; seeing infrastructure corridors through a more accurate and more spatial conceptual framework has the potential to create new design opportunities. My research, then, is also based in observation toward the goal of intra-profession advocacy—seeking to initiate a dialog about what opportunities landscape architects have in designing the landscapes of existing infrastructure corridors, toward a larger question that has been ignored in the profession: how can the landscapes of existing infrastructure corridors be designed to become beneficial to the culture, economy, and ecology of adjacent communities? These explorations also indirectly confront issues such as the definition of a site and of the types of scales and situations in which landscape architects design landscapes.

As a continuation of debates in the profession of landscape architecture over the past 150 years, the landscapes of infrastructure corridors can be viewed as a potential site of intervention that is another phase in a lineage of the changing origins and histories of the spaces where landscape architects work. From green field sites that were delineated, designed, and implemented before the construction of a city, to left over fragments of urban fabric that resulted from the insertion of technology or transportation, to post-industrial sites that were vacated following the decline of industry in areas of North America, to post-industrial linear sites along water fronts that were vacated following the decline of maritime and railroad shipping[8]—the landscapes of infrastructure corridors present another opportunity for an active field for design where the profession of landscape architecture can attempt to improve the ecological and social condition of the landscape, while also embracing an already established and functioning vector to work with larger scale patterns and processes in both urban, suburban, and rural areas. This approach, however, first requires a concept of infrastructure corridors that is more complicated, more dynamic, and more responsive than that of a line.

A Note on the Phrase Landscape Intervention

Throughout the research that follows, the phrase "landscape intervention" (or the term intervention) appears when discussing the landscapes of infrastructure corridors, both in proposing a new concept of the landscapes and in discussing the specific corridor case studies. This phrase is deliberately vague. It is beyond the scope of my research to propose specific landscape designs for any of the discussed sites or corridors. However, a brief comment on the direction of interventions that might best mesh with the research presented here is necessary. As opposed to recent high-budget post-infrastructure interventions, such as the High Line, intervention in my research is considered as more of a scalable intervention (or condition) that could be deployed in a particular context across a number of sites. This is justified by the lack of concentrated funds that would be available for a project that spans the length of a corridor. Design costs, implementation costs, and maintenance costs would have to be low, driving any intervention toward an agricultural ethos. Therefore, when intervention appears in the text that follows, it assumes this scalable approach without adopting a specific program.

[1] Infrastructure is a troublesome word, in that it tends to be relational and also tends to be a catchall term for a variety of types and scales of project. (See Susan Leigh Star, "The Ethnography of Infrastructure," *American Behavioral Scientist* 43, no. 3 (November 1, 1999): 377–91.) My research requires no strict definition of the term infrastructure. Instead, by attaching the term corridor, my research is more concerned with the spatial structure of any infrastructure that trends toward extending significant distances.

[2] See, for example, any highway road map, where roads are depicted at an unvarying width through various surrounding land uses and topographies. Also see any of the maps that the U.S. Energy Information Administration maintains at www.eia.gov/state/maps.cfm. See also D'Amros and Zancan's discussion about how the representation of leftover spaces adjacent to infrastructure corridor has shifted through time, "Infrastructure's Marginal Spaces and the Invention of a Prosaic Landscape—Visual Knowledge and Design," in *Infrastructural Urbanism: Addressing the In-between*, ed. Thomas Hauck, Regine Keller, and Volker. Kleinekort (Berlin: DOM Publishers, 2011), 63–81.

[3] Dennis Shaffer, Andrew Maynor, and Windy Roy, "The Visual Perception of Lines on the Road," *Perception & Psychophysics* 70, no. 8 (November 2008): 1571–80.

[4] Karl Kullmann, "Thin Parks / Thick Edges: Towards a Linear Park Typology for (post)infrastructural Sites," *Journal of Landscape Architecture* 6, no. 2 (September 1, 2011): 70–81.

[5] Boris Pushkarev made a similar argument in 1960, before the dramatic twentieth century rise of engineered infrastructure corridors. See B. Pushkarev, "The Esthetics of Freeway Design," *Landscape* 10, no. 2 (1960): 7–15; Christopher. Tunnard and B. S. Pushkarev, *Man-Made America: Chaos or Control?: An Inquiry into Selected Problems of Design in the Urbanized Landscape* (New Haven: Yale University Press, 1963).

[6] On scale, see Anita Berrizbeitia, "Scales of Undecidability," in *CASE: Downsview Park Toronto*, by Julia Czerniak (Munich; New York; [Cambridge, Mass.]: Prestel ; Harvard University, Graduate School of Design, 2001), 116–25; Linda Pollak, "Constructed Ground: Questions of Scale," in *The Landscape Urbanism Reader*, ed. Charles Waldheim (New York: Princeton Architectural Press, 2006), 125–39.

[7] See, for example, Elizabeth Mossop, "Landscapes of Infrastructure," in *The Landscape Urbanism Reader*, ed. Charles Waldheim (New York: Princeton Architectural Press, 2006), 162–77; Pierre Bélanger, "Landscape as Infrastructure," *Landscape Journal* 28, no. 1 (2009): 79–95; Pierre Bélanger, "Redefining Infrastructure," in *Ecological Urbanism*, ed. Mohsen Mostafavi and Gareth Doherty (Baden, Switzerland: Lars Muller, 2010), 332–49; Pierre Bélanger, "Landscape Infrastructure: Urbanism Beyond Engineering," in *Infrastructure Sustainability and Design*, ed. Spiro N. Pollalis (New York, NY: Routledge, 2012), 276–310; Clare Lyster, "Landscapes of Exchange: Re-Articulating Site," in *The Landscape Urbanism Reader*, ed. Charles Waldheim (New York: Princeton Architectural Press, 2006), 219–37; Jacqueline Tatom, "Urban Highways and the Reluctant Public Realm," in *The Landscape Urbanism Reader*, ed. Charles Waldheim (New York: Princeton Architectural Press, 2006), 178–95; Thomas Hauck, Regine Keller, and Volker. Kleinekort, eds., *Infrastructural Urbanism: Addressing the In-between* (Berlin: DOM Publishers, 2011); James Corner, "Terra Fluxus," in *The Landscape Urbanism Reader*, ed. Charles Waldheim (New York: Princeton Architectural Press, 2006), 23–33; Alex Wall, "Programming the Urban Surface," in *Recovering Landscapes*, ed. James Corner (New York: Princeton Architectural Press, 1999), 233–49. A more extensive list of tests that draws from a wider range of time can be found in the literature review included in this thesis.

[8] Van Acker argues that iterative infrastructural projects developed over time created fragmented, leftover spaces. Maarten Van Acker, "Re-tracing the Ringscape—Infrastructure as a Mode of Urban Design," in *Infrastructural Urbanism: Addressing the In-between*, ed. Thomas Hauck, Regine Keller, and Volker. Kleinekort (Berlin: DOM Publishers, 2011), 33–47.

Chapter Two:
Infrastructure Literature Review

Since infrastructure has had many contrasting definitions in different times and places, and has assumed different values and meanings to different groups of people, the cultural and technological context in which a body of literature about infrastructure is written determines how valid that body of work will be to any research involving infrastructure.[1] Infrastructure is inherently relational.[2] This point has caused this review to be limited both geographically and temporally, restricting this discussion of infrastructure to a specific cultural context. (Further, the research here is not intended, in any way, to be historical; no comprehensive history of the design, construction, or maintenance of infrastructure is offered.[3]) As the research addressed in this thesis is focused on the spatial structure of existing infrastructure corridors within a state of an industrial (and in places post-industrial) nation in the Western world, I have examined texts written about infrastructure in the United States and Western Europe.[4] These nations have shared a similar development, apex, and then decline of industry, and all have developed extensive networks of transportation, communication, and conveyance that have required the construction of infrastructure corridors.[5] Although this statement may border on historicizing, in the pejorative sense, the infrastructural history of multiple nations—and it certainly oversimplifies the current state of infrastructure development as related to information technology—this common heritage allows texts written about infrastructure in these nations to share a common timeline and geographic (as in the shape and condition of the land) context.

However, even this geographic limit would not provide sufficient limits to this literature review. An element of time must be introduced. More specifically, the concept of a time map as established by Eviatar Zerubavel provides a method to select patterns of response to events—in this case response to infrastructure.[6] Zerubavel writes about narratives of time that reflect ascendance or decline. Actions and responses in time have vectors and inertia that can be traced. This can be applied to infrastructure: 1800 through 1973 represented an ascending narrative of infrastructure as canals, railroads, interstate highways, natural gas pipelines, and electric transmission lines were developed in a rapidly industrializing culture with increasing scales of technology.[7] Kenneth Clark, in his television series on the development of civilization, once called this a period of "heroic materialism." Following this period, there has been a time of reduced expansion, stasis, or even decline, where massive infrastructure projects are occurring with less frequency and a time of maintenance and deferred maintenance has developed. (An exception to this is the continued development of high-speed rail, natural gas pipelines, electric transmission lines, and fiber optic communications, though these developments are often occurring within the rights-of-way of earlier corridor projects.) Rosalind Williams has called this a time of dematerialization—though she traces the origins to the much earlier development of the telegraph—as the conveyance of data has continued to consume a larger portion of economic growth and thus infrastructure funding.[8] Building on this line of thought, this literature review is largely restricted to post-1960 texts written about infrastructure, corridors, and related theory developments in urbanism and ecology. Based on Williams' 1973 date, my selected beginning date also includes the last decade of major highway construction. Although at times the selected texts have hints of

Clark's "heroic materialism"—perhaps the echoes of this phase that still most visibly permeates the fields of regional planning and civil engineering—they primarily address Williams' dematerialization but also suggest a twenty-first century concept of the rematerialization of landscape and infrastructure with a reconnection of already-built infrastructure corridors to the wider landscape. This is ultimately where my research presented here aspires: a study of the spatial structure that might encourage a rematerialization of existing corridors within the surrounding landscape. As this specific subject of research lacks a cohesive literature, I have had to address it obliquely through related texts.

Following these limitations discussed above forces me to omit two bodies of literature: historic civil engineering texts that address the construction of infrastructure; historic landscape architecture texts that discuss the design and embellishment of railroads in the nineteenth century and then parkways in the early years of the twentieth century.[9] Of these, texts that discuss the design of parkways seem to be the most relevant to my research; I have decided to exclude them here because many of the historic texts are too focused on new construction to be of value to my research, and the present-day, historic studies tend to ignore the spaces created by the design of parkways. One exception is a description of parkways by Norman T. Newton in *Design on the Land*: "The parkway was *not* itself a road, it *contained* a roadway. The strip of land was not just a highway with uniform grassy borders; it was of significantly varying width, depending on immediate topographic and cultural conditions."[10] The idea of parkways as an arrangement of sites with a road corridor running through them helps to frame the literatures I do address in this review: 1) a selection written in the 1960s that begins to address the impact that highways had on surrounding communities and views highways as more than a streamlined corridor of efficient motion; 2) the emergence and then acceptance of the term infrastructure within the spatial design fields and the rise of Landscape Urbanism (1980-2006); 3) the reception of Landscape Urbanism's concepts and how it has been catalytic to an abundance of texts that address infrastructure (2006-2014).

Designing Interstate Highways (1950s-1960s) [11]

Interest in the design, spatial structure, and experience of interstate highways emerged following the enactment of the National Interstate and Defense Highways Act in 1956.[12] Following this policy development, highways became a major element in discussions about the landscape of the United States, often used as a prime example of the scale of infrastructure imposed on the expansive North American continent.[13] Although many of these texts predate the common use of the term infrastructure, many of the aspects that these texts discuss regarding highways reappear in later twentieth century discussions of infrastructure. These texts can be seen as discussing how to design infrastructure through the use of highways as a specific case.[14]

In 1956, Wyane Scott published an article in the journal *Landscape* that uses the first highway project in New Mexico as a case study.[15] Scott's initial purpose is to outline how little anyone, including Congress, understands of the changes that the highway system will inflict upon the landscape. His concern regarding these changes is how the imposition of a highway corridor will affect surrounding land use and access—i.e. how will the highway system be catalytic of other, unknown changes in the landscape? Many types of changes are discussed, including access to existing and new roads, division of private lands, limited locations for businesses to be started by local residents, and the effects of highways on land value. These changes are noted within the specific geography and climate of New Mexico. An example of a rancher who would own isolated, nearly inaccessible parcels of land due to the highway construction is discussed at length. Scott's article reveals that even in the first years of construction of the interstate highway system some individuals (though not decision makers) were concerned and observing the spatial changes that highways would create beyond the construction of the corridor.[16]

Differing from Scott's descriptive and somewhat critical comments, the immediate response to the National Interstate and Defense Highways Act by landscape architects and architects was more practical, even enthusiastic. Highways offered an opportunity for landscape architects to intervene on the landscape at a previously inaccessible scale. "Motor Roads in the Modern Landscape" by Desmond Hennessey outlines the major opportunities for the design of highways.[17] Although Hennessey's article appeared in a journal in the United Kingdom, many of the examples cited are selected from the United States and Germany. Quick to acknowledge that Germany has been at the forefront of designing highways, Hennessey assembles a list of the major locations, objects, and experiences that can be designed along a highway. His treatment of each opportunity is brief, including glimpses into how the design curves, roadside buildings, bridges, and gradients can be improved. In a series of diagrams at the conclusion of the article, he illustrates four concepts that could be applied broadly: "internal harmony," "congruity with landscape," "earthworks," and "planting," which includes thoughts on how a highway might enter and pass through a forest.[18] These concepts have been adopted, repeated, and expanded by later writers and applied to other forms of infrastructure. Adding to this enthusiastic response, in 1958 a lecture by G.A. Jellicoe that addresses the design of motorways was published in the *Journal of the Town Planning Institute*.[19] Jellicoe's speech is broken into three sections: a historical review of highway design in the United States and in Germany—the only two foreign examples that Jellicoe thinks should have influence on British highway design; a brief history of the English landscape tradition and how it should influence highway design; then a detailed procedure listing how highways should be designed using an iterative process with an interdisciplinary team of planners, engineers, and landscape architects. Jellicoe briefly discusses the influence a highway has on the surrounding landscape and the spaces that a highway creates through imposition on an existing landscape. This is first shown in his discussion of "geographical variation" and in his description of a specific highway design response between an existing brewery and newly constructed highway.[20] Toward the end of the article, in a listing of design strategies, Jellicoe discusses the design and land acquisition involved in a highway design. His most relevant argument is that when a highway is placed in an already inhabited landscape it divides many parcels into fragments. While some of the remnant fragments are inhabitable and can still function (in this case) as farms, others cannot. In those cases, Jellico suggests purchasing these fragments to incorporate them into the experience of the highway. Unfortunately, this is a brief point and he does not further examine how these spaces might be used. There is, however, an awareness of seeing a highway right-of-way as more than symmetrical buffers.[21] It is important to note that this concern for the spaces created by highways was present in the earliest highway writings by landscape architects.

The Highway and the Landscape, an edited collection of articles discussing various aspects of highway design published in 1959, further continues this tradition of optimism and enthusiasm.[22] Although some of the articles are reprinted from the proceeding five years, the coupling of "highway" and "landscape" in the title is quite important in revealing continued spatial concerns of the highway, even though the connector "and" is used rather than "in." The foreword quotes a 1944 report of the National Interregional Highway Committee at length, concluding with a remark that argues highways should not be the "unsightly and obstructive gashes feared by some—but rather elongated parks bringing to the inner city a welcome addition of beauty, grace, and green open space." [23] This sentiment is clearly a vestige of the parkway ethos. Two chapters of the book are of particular relevance.

"The Art of Fitting the Highway to the Landscape" by F.W. Cron, an engineer and honorary member of the American Society of Landscape Architects, is revealing in noting that the highway should be molded to the landscape rather than modifying the landscape for the highway.[24] Cron writes at length on defining the elements of a highway, primarily surface, curve, and grade that can be designed to best mesh with the existing landscape. Although admitting that much of what highway engineers are accomplishing consists of new discoveries and new real-world tests, Cron notes the influence of railroad design on highways. More specifically, he notes how differences in technology between locomotive and automobile allow highway engineers more flexibility in merging landscape and highway. Survey techniques to locate an appropriate roadway are briefly discussed, and Cron notes the importance of using airplanes and aerial photographs in order to increase "the locating engineer's effectiveness manyfold."[25] From the perspective of an aerial photograph, Cron argues, an engineer is given a more holistic and comprehensive view of the surrounding landscape, providing more alternatives for the route than a foot survey would identify. Cron's awareness of a regional perspective is vital. Although Cron initially maintains a neutral tone on the works of highway engineers, on page 86 he begins to suggest that the engineer's working method is too single-minded and too goal-oriented to locate the best route for a highway. Again, Cron is arguing for a more holistic approach that considers all potential influential factors, not only those that an engineer is best equipped (and educated) to address. This holistic approach is also urged in the placement of the highway through the landscape by considering the topography, scenic, and cultural value of surrounding landmarks and parcels of land. However, Cron at times reverts to a blind efficiency, which is countered in the last paragraph of the chapter: "There is no such thing as a science of location that will give mechanical or infallible answers…. Highway location is an art in which many skills are employed to resolve a myriad of conflicting demands." [26]

More explicitly spatial and concerned with how a highway can leverage the qualities and spaces of the surrounding landscape, "Preserving the Scenic Qualities of the Roadside" by Wallace A. Johnson, a landscape architect, begins with a brief case study of the Mississippi River Parkway.[27] Originally meant to be a traditional, non-commercial parkway along the entire length of the river, early studies by the National Park Service revealed the project would be devastating to local towns and economically unfeasible. However, an alternative was proposed where the experience of a parkway could largely be constructed through the use of easements and nodes of scenery and recreation rather than a continuous corridor of government ownership. Johnson argues that this approach should be applied to the construction of all highways. The main point of Johnson's argument is that the characteristics of a highway—in response to topography, scenery, cultural values, construction requirements, and economic restraints—presents opportunities for the highway to interact with the surrounding landscape. These interactions create usable sites beyond the boundaries of the highway's concrete surface. A variety of examples are cited: borrow pits from construction, areas with low land value that allow for an expansive median area, adjacent marginal farms, and intersecting streams and rivers. How the highway interacts with these elements creates opportunities for a highway to be designed as a wide zone of land rather than a narrow corridor, thus allowing compatible programs to coexist with the development and continued use of a highway. Johnson is concerned with functional issues—such as windbreaks and highway safety—but he is also interested in how parcels of land adjacent to highways can be used for recreation. Throughout the article Johnson maintains a prescient awareness of the spaces and sites that highways will intersect, occupy, and divide—and he takes the proactive approach that these issues should be considered during the acquisition of land for the highway in order to streamline the process. Johnson's writing lacks specifics for the precise program or spatial arrangement of these lands, though the patterns of sites he proposes can be implied from the 21 photographs (most of them aerial photographs) placed within the article. In these photographs, the surface of the road is depicted as only one element within the larger landscape.

Two additional publications from this time further elaborate on these spatial concerns. *Studies of Highway Development and Geographic Change* presents a number of studies that address how a highway will affect the surrounding areas, though these concerns are primarily about land-use changes. The use of geographic change in the title, however, points out how highways were seen as agents of change. Unfortunately, what is missing from this study is any recognition of the shapes of the highway itself. Published in 1960, Sylvia Crowe's *The Landscape of Roads* does address this concern. While many of the presented principles and ideas had appeared in the earlier publications mentioned above, Crowe makes the specific contribution of studying the placement of highways within the various landscapes present in Great Britain. This geographic specificity moves Crowe's study beyond the abstract spatial concerns of *Studies of Highway Development* and presents specific examples of the influence of highways on specific surrounding landscapes. Even in a relatively small nation, Crowe discovers that highways interact with a multitude of surrounding landscapes and that each different landscape presents opportunities for the design, form, and experience of highways.

All of these sources, implicitly or explicitly, examine the divide between the ethos of the engineer and the landscape architect in building infrastructure: the engineer focused on efficiency and quantifiable metrics; the landscape architect focused on a more holistic approach to the wider landscape and maintaining concern for the experience of individuals using infrastructure. This has proven to be an enduring, even cyclic theme in the infrastructure literature of the twentieth and early twenty-first centuries. A brief yet prescient 1962 article, "Highways as Scenery," argues for the landscape architecture's holistic approach in the design of highways.[28] Examples are drawn from California, England, and Germany, all pointing toward the landscape architect's continued involvement in highway planning, design, and maintenance as a holistic process that involves economic, social, scenic, and recreational concerns. The remaining texts in this section of the review argue for various aspects of this holistic approach.

Boris Pushkarev published an article in 1960 titled “The Esthetics of Freeway Design.” [29] Pushkarev considers highways to be a “cultural asset” that has for too long been ignored and treated only as a utilitarian object,[30] arguing that highways have the potential to become an asset to the surrounding communities. His analysis of highways, however, is largely limited to the experience of driving along a highway, especially how scenic values might be added to that experience. A strong connection is made to the design of earlier parkways. There is little discussion of how a highway might contribute to an adjacent community beyond when a resident is driving on the highway. Toward improving an individual’s time spent on a highway, Pushkarev outlines a series of experiential factors that might define the manner in which landscape architects could design the experience of a highway. Further, he argues that while much research is being conducted into efficiency, safety, and funding of highways, little research is being conducted on the best form of the highway. There is, however, little discussion of how “form” is defined in this situation. In writing about buffers along highways, of the scale of sites that exist at cloverleaf intersections, and of mass planting along highways, Pushkarev hints at dealing with the spaces alongside the corridor. However, these spaces are never given a full treatment. There are, however, two additional points that speak to how the highway is connected to the wider landscape. A brief discussion on page 14 of the article discusses the acquisition of surrounding parcels to improve the esthetics and the functional aspects of a highway. While highway departments have long considered adjacent properties another organization’s concern, Pushkarev argues that “the totality of highway functions" must be considered and that "a protective greenbelt is just as much a part of the freeway as shoulders and guiderail," making its acquisition the responsibility of the highway department.[31] Taking this point further, Pushkarev argues that on a large scale a freeway is an "integral part of the 20th Century community—the interurban region."[32]

An article written in 1961 by Brian J.L. Berry and William L. Garrison, "Cities and Freeways," expands upon this latter point.[33] Berry and Garrison begin to discuss urbanized zones around cities and their relationship with highways in terms such as system and pattern, concluding that highways will "play a fundamental role in shaping the U.S. of tomorrow…." [34] Highways are called "an urban system", terminology that presages discussions of infrastructure of the later twentieth century.[35] For context, it is worth noting that this article appeared only a few years after the Odum brother's *Fundamentals of Ecology*, perhaps showing an early yet unacknowledged influence of ecology on discussions of infrastructure and infrastructure corridors—a trend that has continued in infrastructure literature to the present day.[36] Lewis Mumford in "The Highway and the City," further explores the implications of a highway affecting the spatial arrangement of cities.[37] Mumford takes a more critical approach to the engineer's often myopic solutions, particularly when forcing a wide highway through cohesive urban fabric, though he fails to propose an alternative, instead adopting the rather nihilistic—but unfortunately prescient—view that there is little any engineer or urban planner can do to control the destruction that will be caused by highways. This type of social criticism, with Mumford presented as a single example, seems to have had an influence in urging landscape architects toward engaging with the design of highways, particularly in the context of on-going and contentious debates about the placement of highways through urban areas.[38]

Pushkarev expanded upon his article written in 1960 when he co-wrote *Man-made American: Chaos or Control* with Christopher Tunnard in 1963.[39] The portion of the book that deals with highways takes the title “The Paved Ribbon: The Esthetics of Freeway Design” and is then further separated into three chapters: “The Development of Freeway Form,” “The Internal Harmony of the Freeway,” and “The External Harmony of the Freeway.” [40] Many of Pushkarev’s insights into how to design the experience of highways are repeated from his earlier writing, even if lengthened. However, Pushkarev’s insights reach into a number of new topics and concepts. The development of highway form is traced through Germany and the United States, first with the comprehensive system of the autobahn Germany and then to individual interventions of cloverleaf intersections and multi-lane divided highways in the eastern United States. This is one of the few historical studies of the development of highway form from this time. Two diagrams are also presented that show the extent of the highway systems in both nations in 1960. As Pushkarev begins to discuss contemporary highways, he notes there are three aspects to study: structure, function, and form. Structure, defined as concerns of soil foundation and the composition of pavements, and function, the use of the roadways by vehicles, are receiving adequate attention among researchers, Pushkarev argues. Form, however, has been given little attention. He writes that the highway is “very much like a piece of architecture or industrial design…where scientifically determined functional limitations leave the designer considerable freedom to give the object intuitively a more refined and unique expression.” [41] Pushkarev claims to be investigating the visual appeal of highways, a point that is traced, again, through the historic development of highways. Through this historic study, Pushkarev states two types of visual studies into highways: those that focus on how the highway relates to the landscape; the visual attributes of the highway itself. This allows Pushkarev to then divide the remainder of the chapter into the internal harmony of the highway and the external harmony of the highway.

Internal harmony is seen as the flow of the ribbon of asphalt through the landscape and the motion of the car on that ribbon. Pushkarev sees the design of both as analogous to sculpture. While Pushkarev's argument is primarily aimed toward designing highways as a continuous system of arcs connected by spirals rather than long tangents connected by circular arcs,[42] he does venture into a discussion of the "harmony of enclosed areas" where he notes that designers must give critical attention to the spaces between lanes of traffic (the median), as highway users perceive these spaces through motion.[43] Thus, how these medians are planted and shaped is of high importance.

External harmony is how the highway relates to its surroundings. Pushkarev notes that this relationship must be designed at a macro and micro scale, a point mentioned in his 1960 article but expanded upon here. On the macro scale, Pushkarev discusses how highways must relate to the terrain, to geology via rockcuts,[44] provide an awareness to users of the natural processes that have formed that land, and of earlier forms imposed in the built environment. All of these begin to illuminate spatial aspects of highways. However, Pushkarev then establishes a brief yet important argument where he states that a freeway should be seen less as a line and more as an area of land that includes that space between lanes and traffic and the buffer placed on either side. This is an early acknowledgement—though somewhat repeating the design of parkways—that a freeway can be see as an aggregation of sites linked by a corridor rather than only a corridor. That this point is addressed in the section devoted to the macro scale is also important. Pushkarev is arguing for freeways as an aggregation of sites over a larger region, not just in a specific location. On the micro scale, Pushkarev mentions "embankments, bridges, planning, and a multitude of other design details that the road-user can see from the window of his car, or the non-user from the window of his home." [45] These specific elements are approached through the concepts of cross section, lateral or adjacent spaces, and the articulation of engineered forms such as bridge abutments, and simplicity in required signage. In dealing with adjacent spaces, Pushkarev notes the visual effects of different buffer widths. Drama—which, again, was included in his previous article—is here bound to the spatial. Through diagrams Pushkarev illustrates how road alignment and buffer width can be integrated with the placement of sculptures and monuments to add drama to the experience of driving along a highway. There is also a lengthy discussion about how nodes of recreational and scenic value can be integrated into the highway design. Although this is primarily aimed at purpose built facilities constructed at the time of highway construction, in the photographs and examples cited there is a sense that Pushkarev is also arguing for the later addition of these facilities into the leftover spaces from highway construction.

The apex of this period of literature regarding highways and design in the 1960s consists of two somewhat eccentric monograph-type publications: *The View from the Road* by Donald Appleyard, Kevin Lynch, and John R. Myer, and *Freeways* by Lawrence Halprin.[46] These publications reveal an on-going interest in highways by the spatial design fields and planning, though they also reflect the continued shift toward diagrammatic expression of user experience on the highway. Initiated by the earlier texts discussed above, these two books continue to argue that the current state of highway construction and engineering in the United States is misguided and should be improved. Both consider the highway a work of art.

Although *The View from the Road* begins with a brief historical treatment of scenic highways in the United States, it is clearly expressed that the focus of the book is on the typical, functional highway that most people encounter on a daily basis. The goal of the book is to develop methods of notation and design methods through the observation of existing highways. In this approach of observation, this book along with *Freeways* represents a shift in response to infrastructure. Where earlier texts had few built examples to observe, these two books were written in a time when many built examples could be visited and critiqued. This is the beginning of an analytical tradition in infrastructure research that continues through today, aimed primarily at gleaning insights from study of built works. Anyone familiar with Kevin Lynch's earlier work will notice how his notations developed to study city form are here being applied to the highway.[47] In visually expressing the individual experience of movement along a highway, these diagrams are a valuable study. When paired with the sequential sketches and photographs, the book conveys an overwhelming sense of movement through the landscape. What is missing, however, is any discussion on how this movement relates to the surrounding landscape or any discussion about the spatial implications of changing highway form. To return to the distinction between highway as line and highway as area that Pushkarev outlines, *The View* is a return to highway as line. One deviation from this view is how the diagrams often include the influence of adjacent signage and land use. In these instances, the spaces surrounding the highway are shown to be of importance but not discussed further. The authors note in the conclusion that this study was limited in order to deeply explore a single issue.[48] Specifically, the authors note that they did not examine how a highway affects its surroundings and how it is perceived from beyond the surface of the road. They state that these two perspectives, the inward and outward—or the external and internal as argued by Pushkarev—are radically different problems and require individual solutions. However, they also note that there is work to be done in better understanding how these two problems relate to each other.

Freeways is one of the first (perhaps one of the only) major publications by a practicing landscape architect that addresses the implications of the Interstate Highway System in the United States. Halprin's focus is how a driver experiences a highway and how that highway impacts the experience and spatial conditions of the surrounding landscape, again mimicking the external vs. internal division of Pushkarev. Calling the freeway a "form of art in the city" and noting the "form-giving" potentials created by the design and construction of freeways,[49] he calls the structures associated with freeways "among the most beautiful structures of our age." [50] They represent, he argues, a new scale in human creations. "Freeways do more than move us about; they also mold the shape and form of our cities." [51] This recognition of an increased scale of construction and of mobility—and its influence on how those factors influence the shape of cities—moves Halprin's beyond the purely experiential concerns of *The View from the Road*. However, in this scale and in his focus on the experience and notation of space, the influence of Kevin Lynch's work is undeniable.

Halprin's concentration on experience and motion permeates the book. He writes that the automobile "on the freeway is symbolic of the intense dedication of our age to motion." [52] Views from the road and seeing the skyline and topography are both important elements to Halprin, and he even applies the system of "motation" he developed for designing landscapes to highways. Freeways to Halprin are "large-scale choreography" where "man can be in motion in his landscape theatre." [53] These concerns begin to morph into speculative thoughts on potential multi-use zones for highways. On page 86, Halprin notes how before an elevated freeway in San Francisco was opened to traffic it was opened to the residents of the city to use as a public space. In anticipating the High Line and La Promenade Plantée by thirty years, Halprin notes the importance of seeing the city from this elevated perspective and argues that portions of freeways built through cities should be permanently set aside for this use. If *The View from the Road* typifies a literature of highways that is responsive to already built form, Halprin's book advanced the methods of these observations. His diagrams and photographs depicting movement within the highway corridor and a sequence of photographs depicting someone (perhaps Ann Halprin, a choreographer of dance; his wife) dancing through the concrete structures of an overpass both reveal how experience is linked to already created form. However, he shifts away from the corridor itself and examines the form of the highway structures and how they cut through the landscape. The experiential representations are augmented by aerial images of the structures and forms created by highways.

Although Halprin largely examines urban areas, he extends his study into the countryside when examining the spatial opportunities created by highway design. He discusses how highways should be built through the landscape by discussing a number of rules originally proposed by Sir Humphrey Repton. In these there are many points in which Halprin writes about how the highway interacts with the surrounding landscape. In the most relevant points, he argues that highways should have wide medians that are well planted, move around important topographic and geologic features, have wide buffers that are generously planted, and should have rest stops that somehow improve the experience of the driver through the design of the landscape. However, Halprin is quick to note that the forms and materials used within urban areas—a phrase that he uses to indicate traditional urban zones, not the horizontal urbanism proposed by later landscape urbanists—must be different and architectonic in character. This discussion largely lacks specifics, however. Halprin concentrates on the construction of highways, not how to alter what has already been built—an appropriate attitude at this early point of the development of the highway system. Much of the book is therefore projective, arguing for a change in the way freeways are designed. His optimism is palpable. His proposed designs are a progressive vision for the development of form and motion as highways interact with cities. Although Halprin expresses an interest in spatial concerns, he switches back and forth between spatial as defined by the experience of a user and spatial as defined by the boundaries of a site adjacent to the highway. While few specifics are offered for the latter category, Halprin does discuss the potential for designed sites beneath freeways and arguments that interchanges present the opportunity for designers to create "form-giving events."[54]

One of the most important points is Halprin's argument is that the specifics of engineering highways have been designed and built successfully but that, in contrast, how these constructed elements affect the surrounding areas has been largely uninvestigated. Study into the reception of these large-scale interventions is missing. Specifically, Halprin argues that a technique to study the aesthetic qualities of movement through space has not been developed. In a way, this book can be seen as a step toward that technique. However, Halprin extends this idea, stating "we need to evolve mechanisms for the projection and analysis of linear structures over long distances so we can visualize their impact both on the macro-landscape and the micro-landscape." [55]

Halprin was also involved, as one of eight advisors, in the 1968 publication *The Freeway in the City*, a report to the Secretary of the Department of Transportation.[56] From the start the publication has a high modernist social improvement ethos,[57] primarily through arguing that the expenditure of large sums of money and large-scale manipulation of the landscape to build highways will improve social and economic opportunity. However, instead of generalizations the publication is an extended list of planning, policy, and design recommendations, all with the goal of ensuring that a highway enhances the experience of a city and the quality of life in the surrounding neighborhoods. Toward this goal, there are recommendations that involve the use of adjacent parcels of land and parcels of land within the highway right-of-way. The publication argues for the multi-use of these lands. More specifically, it is noted that these sites hold the potential to be recreational amenities to a city. As with Jellicoe's 1958 speech, an emphasis is placed on the acquisition of fragmented parcels before the construction of the highway, as these can be purchased for a relatively small additional percentage of a highway budget. Further, the book speaks of an ecological approach to urban design and a systems approach to the planning of highways. Both of these terms seem to presage Ian McHarg's *Design with Nature* that was published in 1969.[58] McHarg directly addresses the process of highway location, stating that the method he proposes is "an attempt to remedy deficiencies in route-selection" by looking at the biological, social, and topographic factors that should either encourage or discourage the specific highway route.[59] This process is more data intensive and gathers from a wider selection of sources than the systems analysis proposed in *The Freeway in the City*. However, McHarg's method is limited to this analysis while in *The Freeway in the City* it is clearly acknowledged that the systems analysis is not design; it is only a starting point that provides reliable context and information for the design.

In summary, this period of literature addressing highways is focused on how to study and then improve the experience of a user on a highway, though there are moments in all of the major texts that indicate the continuation of concern for how the construction of highways is affecting the surrounding landscape. There is also awareness of the potential for existing sites along a highway to be used for other programs. Infrastructure during this time period is linked to the specific sites of highways, which is understandable given that this was the major practical application of infrastructure during this time. However, it is also worth noting that very few, if any, of these ideas were implemented in the United States. A gap existed between practical application and theoretical writings, which still persists today in new construction and is visible in the continental-scale highway system that was constructed in the twentieth century.[60]

The Rise of Infrastructure (1980 - 2006) [61]

According to David Gobel, infrastructure emerged between 1964 and 1984 as a term for the "interactive, functional components" that provide necessary services within an urban area.[62] The term replaced the earlier, equally ambiguous phrase "public works."[63] Gobel provides a brief historic overview of the development of infrastructure and the regional perspective of a city, noting the work of Herbert Spencer, Lewis Mumford, and Patrick Geddes. This leads Gobel to ask: "What is the relationship [of infrastructure] to the meaning of the city?"[64] To Gobel infrastructure is a modernist idea and argues that without the term we would be left without a precise category to study the functional sites of a city. With a brief detour through the categories of public projects as defined by Vitruvius, Gobel makes the argument that infrastructure must not "divorce the city from its organic source." [65] Infrastructure emerges in Gobel's short article, written in 1984, as a holistic category to discuss the quotidian, functional elements of a city—e.g., pipes, sewers, treatment plants, electricity generation, transportation networks, and conveyance corridors—in relation to natural processes. Gobel's concern is with the spatial design fields. While this article outlines most of the primary concerns that inspired spatial design disciplines to address infrastructure, it must be noted that this article appeared within a larger national discussion of infrastructure in the United States.

The release of *America in Ruins: Beyond the Public Works Pork Barrel* in 1981 by the Council of State Planning Agencies aligned with the start of a nearly two-decade period of discussion over the status of infrastructure within the United States.[66] Much of this discussion was directed toward a crisis of infrastructure, either of a lack of necessary infrastructure, a lack of funding, or a lack of required maintenance. Even without using the term infrastructure in its title—showing that the term was not yet widely accepted—this book represents a situation where the lifespans of post-WWII infrastructure projects were reaching an end or at least required significant maintenance. Largely focused on economic metrics and policy guidelines, the publication does not mention the design or planning of public works; any projects are seen as single-function projects. "A Conceptual Framework for Thinking about Urban Infrastructure," written in 1984, also reflects this tone, beginning by noting that recent years have been filled with warnings of a " 'crisis' in the nation's urban infrastructure." [67] This situation is tied to aging infrastructure. While most other discussions of this impending crisis focused on dilapidation and lifespan, this article notes that there is the possibility that the demands being placed on infrastructure are changing—i.e., the existing systems are not decrepit; they simply fail to meet the current needs of the urban population. The article is particularly valuable as it is the result of a roundtable discussion from over forty engineers, planners, and scientists. Many different perspectives are presented. From this roundtable, three major concerns were common: First, the article makes the argument that there is no singular infrastructural crisis. Rather, each individual city and region must address a different situation and context. Infrastructure, the article seems to argue, defies any singular definition and must be seen as a formula between the geography, economy, and history of a particular city. Second, beyond funding maintenance and replacement for projects that are exceeding their lifespan, the article argues for a systems approach to infrastructure that moves beyond the typical boundaries of the physical constructions of engineers and into the social constructions of a city's population. In this systems approach, the article calls for the interaction of both physical and social systems. Third, and perhaps most abstractly, the definition of what is considered infrastructure must be changed and focused toward "invention and innovation." [68] Throughout the article, ideas of social demands and social perception are highlighted as key points to guarantee the successful construction and maintenance for large-scale infrastructural systems. "A Conceptual Framework" appeared in a special issue of the journal *Built Environment* that was titled "Infrastructure: Decline and Fall." The response to the infrastructure crisis varies in the other articles. In "Hard Choices: Responding to America's Infrastructure Problems," Marshall Kaplan argues for a more rational approach to the policy and funding of infrastructure.[69] "Infrastructure and Regional Development: Theories" and "Infrastructure and Regional Development: Empirical Findings" both discuss various relationships between the planning and construction of infrastructure and changes to the regional economic situation.[70] In the latter three articles, there is a noticeable trend toward infrastructure as an abstract term that is largely being removed from a specific geographic context. There is no explicit call to shift the design of infrastructure from engineers to designers, though in calling for a new type of infrastructure all of the articles imply that a change in approach is necessary.

The trend toward depicting a crisis of infrastructure continued for the next decade. In 1989, "Infrastructure Shortfall: The Institutional Problems" by Ralph Gakenheimer claims "[a] crisis shortfall is in the making for American infrastructure systems." [71] Many of the reasons for the crisis are identical to earlier articles, though Gakenheimer is more specific, providing five reasons why he believes this crisis has developed: 1) "the historical rhythm in building facilities," which has created an intense period of maintenance and reconstruction after an extended period of building earlier in the century; 2) "political convenience," allowing "boosters" to focus on the economic growth created by new projects rather than the savings and longevity offered by routine maintenance; 3) "institutional misfits," in which "financial instruments" have demanded a focus on financing new projects rather than securing steady funds for maintenance; 4) "unexpected high costs of rehabilitation;" 5) "technology lag," where new technology is primarily applied to the development of new construction rather than to developing more efficient and cost-effective solutions for maintenance.[72] In conclusion, Gakenheimer identifies the unlucky chronology of previous construction as the main cause of the crisis.

Regardless of the reasons for the crisis, the importance of recounting articles that support or discuss the infrastructure crisis is to point out that by the 1990s infrastructure had become an accepted term and that it permeated both the popular press and the academic literature of the spatial design fields. Further, infrastructure was becoming an increasingly abstract term that garnered cachet through its ambiguity; it was a catchall term that spoke to the general relationship between culture, space, and technology without the restriction of specifics. Therefore, supported by over a decade of previous discussion, it is not surprising that writings on infrastructure emerged within the spatial design disciplines at this time.

Before surveying this literature, however, I want to offer speculation on how the cause of infrastructure was assumed by the spatial design fields. The publication of two books in 1984—Anne Whiston Spirn's *The Granite Garden* and Michael Hough's *City Form and Natural Process: Towards a New Urban Vernacular*—seem to both be key in this lineage.[73] Although both avoid direct discussions of infrastructure, each book presents a holistic approach to the design of urban areas, essential an integrated systems approach, and makes an allowance for natural processes to influence the design of cities and technology—both key elements of later infrastructure articles, especially those written within landscape architecture.[74]

In turning to texts produced by designers, the idea of an infrastructure crisis is still present in two articles from 1993, "Infrastructure Reconstructed" by Robert Bruegmann and "Toward a New Infrastructure" by William Morrish and Catherine Brown.[75] After the requisite introductory paragraph that mentions the crisis, Bruegmann argues, in contrast to the earlier literature, that money is not the best response and that the application of design to infrastructure may be the best means of addressing the crisis. Without offering many specifics of what design might offer to infrastructure, Bruegmann references *Man-made America: Chaos or Control?:An Inquiry Into Selected Problems of Design in the Urbanized Landscape*. This reference is to show that designers had made attempts earlier in the twentieth century to design infrastructure; they had ideas, theory, and texts that argued for a more holistic design of infrastructure that embraced topography and cultural concerns. But these designers were unsuccessful in implementing these ideas. Instead, engineers have since that point dominated the creation of infrastructure with ideas of technical efficiency. Bruegmann notes this parallels a larger concern about the nature of the built environment as completely separated from its organic context. This point is vague and not well explored in the article. However, it represents a potential connection between infrastructure and a wider, more holistic perspective on the design of landscapes, including cities, that emerges after the turn of the twenty-first century with landscape urbanism. Suggesting that designers have much to offer to the construction of infrastructure, even if their perspective has been ignored for

30 years, Bruegmann suggests that designers are best able to "reconcile aesthetic concerns with programmatic necessities." [76] But he is then quick to temper this praise, arguing that the idea that designers alone could better plan infrastructure is also a bias; a better solution is to allow engineers and designers to collaborate, to design infrastructure. Although the end of the article makes a flimsy statement that designers might be best suited to representing multiple landscape scenarios to citizens—essentially placing the designer in a subservient role by saying a designer's purview is representational, not material—the idea of interdisciplinary design for infrastructure is prescient and appears frequently in infrastructure literature over the next few decades. In contrast to Bruegmann's article, which is focused more on a disciplinary armature, Morris and Brown primarily discuss the spatial armature of transportation systems within cities. They give specific attention to the ways in which already constructed transportation systems might offer a spatial structure that offers additional opportunities for designers to improve the quality of life within cities. More specifically, Morris and Brown offer comment on how these transportation systems, created by humans, might interact with natural systems that exist in the city or once existed in the city. This complex of systems, they continue, can be used to connect together zones of a city, to engage citizens through public participation, and preserve ecological zones to provide habitat and ecosystem services. Whereas Bruegmann's article is a call to have designers included within the planning of not-yet-built infrastructure, Morris and Brown discuss how to create a new paradigm of infrastructure through the modification of the systems that already exist, arguing for the cultural and ecological appropriation of transportation corridors. However, a weak point of Morris and Brown's article is that infrastructure and transportation systems remain

abstract.[77] There is minimal geographic specificity to their discussion. If the article is seen as spatial, it must be seen as abstractly spatial. A visual study, through diagrams, that reveals the potentials of the transportation corridors in a city would have been a valuable addition. Regardless of this missed opportunity, this article is among the only from the time that deals with the repurposing of existing infrastructure corridors, a trend that reappears in the early 2000s.

In a 1995 edition of *Landscape Architecture* devoted to infrastructure, Morris and Brown published “Putting Place Back Into Infrastructure.”[78] This article takes a significantly different tone, with a focus on how previously utilitarian forms of infrastructure might be transformed into important works of art or cultural icons, a return to the concerns of Halprin in the 1960s. The utilitarian approach, they argue, is tied to a paradigm where infrastructure is hidden from view. Instead, Morris and Brown propose that infrastructure must engage with the imagination of the surrounding community, with an effort toward creating important places in the community. Infrastructure must be brought into view. Instead of utilitarian systems, they state that infrastructure systems need to be seen “as armatures for culture” with three functions: to offer a durable memory to the community, to offer spatial orientation, and to provide education and instruction on how to perceive and appreciate the scale and extent of infrastructure systems.[79] The second half of the article attempts to make sense of how an ecological mindset might be reconciled with infrastructure. However, many of the ideas are fragmentary and lack cohesion. It is important to note the idea of an infrastructure crisis is beginning to disappear as the sole impetus for writing about infrastructure. The term infrastructure by itself has started to accumulate meaning, even if abstractly, and importance.

In the same issue of *Landscape*, Robert L. Thayer published a brief article titled "Increasingly Invisible Infrastructure."[80] Thayer's argument is that hiding infrastructure has created placeless cities. He argues that we must overcome our desire to not see the technology that enables our industrial culture. By accomplishing this, we have the opportunity to build cities with a stronger identity and a better sense of connection with the land. It is worth noting that this article immediately followed the publication of Thayer's *Gray Word, Green Heart*. [81] Although in the book Thayer seems to prefer the use of the word technology instead of infrastructure, many of his ideas presented, such as Western culture's fear of visible technology and how technology and natural systems interact, are directly applicable to infrastructure.

Also in the same issue of *Landscape*, Gary Strang's "Notes from Underground" addresses the hidden complexity of infrastructure on which cities rely.[82] Strang briefly addresses historic aspects of New York City that arise from this complexity. However, the majority of the brief article is devoted to reconciliation of nature and technology. (Both terms remain poorly defined in the article.) Strang notes that this reconciliation presents an exiting opportunity to designers in the creation of landscape form, though he does not follow-through with a more clear definition. The following year, however, Strang published an extended article that better conveys the arguments he attempts to make in *Landscape*: "Infrastructure as Landscape."[83] Strang notes how the inherent opportunities infrastructural systems present for the holistic design of landscapes, by virtue of their scale, have not been leveraged toward built works. Instead, Strang argues, a handful of disciplines—among them, civil engineering, architecture, and landscape architecture—have worked independently and have developed fragmented solutions. As infrastructural systems and urban environments present complex problems that demand a holistic approach, this fragmentation has resulted in poorly built landscapes with short life spans. Although unclear on a precise definitions of a designer (or why a designer might be best suited to manage a holistic design of an infrastructure system) Strang nonetheless assembles a cogent argument as to why these infrastructural systems are ripe opportunities for design. His primary reason is that infrastructure can hybridize with the characteristics, climate, processes, forms, and vegetation of a region to create meaningful, durable form; thus, designers are given the ability to leverage both natural and technical systems to assemble functional and meaningful places. Strang takes this argument one step further and advocates that infrastructure must not be seen as separate from the landscape—that they can be seen as a single system. This focus on a hybrid system allows Strang's argument to extend beyond infrastructure as object to infrastructure as cohesive terrain. His example of seeing the Los Angeles Basin as a watershed (and seeing how it changes through time, both through decades and through seasonal variations) further establishes this approach. Strang also adopts an agricultural metaphor for how an area of land can respond to a region and be multifunctional. Agriculture is appropriate in Strang's argument since he also discusses how nature untouched by humanity is an unrealistic ideal in the late-twentieth century. Perhaps most importantly, Strang recognizes that embracing infrastructure, region, and design is not novel, and he presents a fragmented history of infrastructural systems that embrace landscape or design in three distinct categories. First, Strang mentions the social criticisms of Lewis Mumford in the first decades of the twentieth century. Second, Strang discusses the importance of the form of pre-industrial cities and how some of the most meaningful urban forms were the product of a city forced (by limits of technology) to modify the landscape without obliterating the land's original forms or processes. Third, Strang briefly mentions Frederick Law Olmstead as a landscape architect who understood allowing designs to bend to the requirements of a region, and Frank Lloyd Wright and Iakov Chernikhov as earlier architects who were concerned about designing infrastructure in accordance with natural systems.

With Strang's article it appears that infrastructure has been absorbed within the spatial design disciplines as an accepted and valued concept. Infrastructure no longer requires qualification; the term has leaped beyond being a topical news story and into the realm of theory. Further, Strang's acknowledgement that infrastructure and landscape—or technology and natural processes—often forms a single terrain that a designer can leverage to create meaningful and functional form or process represents the beginning of a landscape approach to infrastructure. This hybridity was earlier discussed by Rem Koolhaas—again, without clearly defining infrastructure—when he wrote how architecture is moving away from the creation of static objects toward the "[discovery of] unnamable hybrids; it [architecture] will no longer be obsessed with the city but with the manipulation of infrastructure for endless intensifications and diversifications…." [84] With Strang, however, the idea is expressed at more length and with more clarity. Strang's complete lack of citations makes it impossible to trace his contemporary influences. However, Richard T.T. Forman's *Land Mosaics: The Ecology of Landscapes and Regions* was published the year before Strang's article and is undeniably a major influence.[85] Forman's writing embraces landscapes as hybrid between natural systems and the built environment.[86] By using terminology such as mosaic, patch, corridor, and matrix—and not drawing distinct lines between natural process and human-altered landscapes—Forman provided Strang and other designers engaging with ideas of infrastructure a holistic vocabulary to think about complex landscapes of natural processes and built form.

Also in 1996—thus adding momentum of the infrastructure conversation—Elissa Rosenberg published "Public Works and Public Space: Rethinking the Urban Park."[87] Rosenberg begins the article by establishing that infrastructure is a necessary component of a city, though one that is largely unseen. Initially infrastructure is used as a negative term, referencing the engineering tradition of the early-twentieth century that was overtly focused on functional needs. However, Rosenberg begins to suggest—in much the same manner as Strang—that infrastructure has the potential to embrace natural systems, not through representation but by harnessing the processes and forms of topography toward functional goals. Rosenberg's goal with this approach is to use a hybrid system of natural and built form to "[break] down the false dichotomy of city and nature…."[88] In a brief historical review, Rosenberg argues that nineteenth century reformers argued for a holistic view in order to solve complex urban problems and that, unfortunately, this holistic view has been recently lost as different disciplines—e.g., architecture, landscape architecture, and engineering—have attempted to draw distinct disciplinary boundaries. Infrastructure, then, seems to be used as a potential and ubiquitous site for interdisciplinary—i.e., holistic—urban design. The article then examines Rosenberg's studio teaching to draw examples to illustrate this holistic approach, further illustrating that at this time infrastructure was being further inculcated into the profession of landscape architecture.

The process of naturalizing the term infrastructure in the spatial design fields continued. In particular, two prominent texts published in 1998 and 1999 that use infrastructure within the title show the changes occurring to infrastructure as a concept: "*Civitas Oecologies:* Infrastructure in the Ecological City" by Kathy Poole; and "Hybrid Morphologies: Infrastructure, Architecture, Landscape" by Marc Angélil and Anna Klingmann.[89] "*Civitas Oecologies"* and "Hybrid Morphologies" share many common conclusions. Most prominent and building on earlier articles, there is a sense that infrastructure can leverage a hybridization between the built environment and natural systems. Poole calls these "built biophysical systems," [90] while Angélil and Klingmann mention connecting the landscape to infrastructure as one continuous system. "They are sediments of one and the same geology."[91] Angélil and Klingmann also use the term topology to discuss this singular terrain.[92] In both articles the purpose of this approach is to break down disciplinary boundaries and to unify the city through the everyday elements of infrastructure. Viewed as a hybrid, infrastructure can be a system that has the potential to break divides between nature and culture, between technology and terrain. Infrastructure is expanded to include—as Poole ambiguously states—a "city's natural ecology." [93] Poole references ecology as a valuable paradigm to view this transformation and examines historical precedents, primarily nineteenth century Paris. In Paris at this time, Poole sees numerous interventions that use infrastructure to harness natural systems, using them not in mimicry but in order to evoke both meaning and function. Poole wishes to "unearth" natural systems and blend them into the functional city—an approach she calls “ecological infrastructure.” [94] Angélil and Klingmann, however, move from a single infrastructural terrain into ideas of process, seeing infrastructure as a device that permits indeterminacy. This process, they argue, allows designers to better see and design the leftover spaces of the city that are the result of previous construction.

If the works presented in this section so far can be seen as a first generation of texts written specifically about defining infrastructure within design, they were followed by a second generation of texts that were responsive, in two different ways, to the first generation. With this second generation, infrastructure is accepted as a naturalized term in the spatial design fields and no longer requires a preface definition.

The first response is to accept the definition of infrastructure as an object (or series of object and spaces) and use it as an opportunity to expand the realm of practice or as a critique of existing practice. In “Urban Infrastructure: The ‘Out of Sight, Out of Mind’ Mentality is an Outmoded Concept,” Barbara Knecht takes a very broad approach to infrastructure, discussing both public art, the role of artists in infrastructure, and the technical and construction details of specific types of infrastructure.[95] The purpose of the article, however, is to note many of the potential business opportunities that architects are gaining through infrastructure. “Expressing the Infrastructure,” by Andrea Oppenheimer Dean, is primarily a discussion with William Morrish, an early proponent of landscape architects designing infrastructure.[96] Although the article briefly explains how Morrish sees infrastructure as a “prism through which we view landscape architecture”[97] and reasserts his earlier arguments of infrastructure as a complex system and infrastructure as a civic goal, the article encourages other landscape architects to take advantage of this new opportunity for project work. Alessandro Rocca in “The Contemporary Landscape of Europe’s Infrastructure” takes a slightly different turn of this response.[98] After discussing the origins of infrastructure based on the efficiency and performance ethos of the engineer, Rocca outlines three modes in which infrastructure “affects or shapes” its surroundings: “[1] by its physical presence and the way its configuration benefits or harms the adjacent area, [2] by the motion it entails and the kinetic view this movement implies, [3] by improving overall mobility and enlarging the range of accessibility.”[99] These modes are then used to critique recently built works, primarily highway-related designs, to discover if the current theory of infrastructure is being applied in practice. There is a dissonance in the article between the critiques of the discussed projects, which perhaps shows how little built work of infrastructure was available to critique. Although there is no absolute acknowledgement that recent projects move beyond the engineer’s efficient ethos, Rocca (perhaps incidentally) makes a strong argument for the redesign of spaces alongside existing infrastructure corridors, as many of the successful projects critiqued exist in those spaces.

The second response is to take infrastructure, now a known entity within the spatial design fields, and skew it towards an author’s intentions in proposing new theory or new design paradigms. This is first seen in “Infrastructural Urbanism,” where Stan Allen shows a willingness to completely co-opt the term infrastructure to illustrate his own ideas.[100] Infrastructure, to Allen, is less a material condition and more a process or approach to the design of the urban condition. Although he mentions the infrastructural crisis, Allen deploys infrastructure as a method for architecture to realize its potential as a realm of material practice while not completely eschewing the post-modernism fascination with signs and meaning. Allen sees "infrastructural urbanism," not as a style or a form but as "a new model for practice and a renewed sense of architecture's potential to structure the future of the city."[101] Engineering, in contrast, is not as well suited to structure the city because of its single-minded focus on efficient materialism, Allen states. The article concludes with a list of seven infrastructural propositions; each mentions infrastructure explicitly. In these propositions, however, Allen dramatically shifts infrastructure away from a built form. Infrastructure becomes a process—not only as a changing condition that facilitates later constructions but also as a process for a designer who conducts "infrastructural work." [102] Infrastructure, as used in Allen's article, has shifted away from only being a material object with defined boundaries. Instead, infrastructure has evolved into a term that represents the continuous terrain of the city, the propagation of conditions that will change over time, the inclusion of multiple voices in a single space, and an awareness that large projects should be built from small details up to large structures. In a way, infrastructure has become both instrument and method, and also has becomes somewhat synonymous, and equally malleable, with contemporaneous debates on the importance of landscape as led by James Corner.[103] Both infrastructure and landscape at this time became a term to represent a design ethos that embraced the ecological, the cultural, simultaneity, indeterminate process, the functional, and overlapping and nested scales—as seen in the occasional intermixing of the terms infrastructure and landscape in *Recovering Landscape.*[104]

Continuing this trend toward the malleable definitions of infrastructure, Hein van Bohemen in "Infrastructure, Ecology, and Art" takes concepts of ecosystems and ecology, and expands them by including infrastructural systems, primarily in the form of transportation infrastructure.[105] Bohemen coins the phrase "infrastructural ecology" to describe this type of ecologically-oriented technical system, which he argues could be considered a new discipline.[106] The specifics of this type of system are not entirely clear from the article, though there is a strong connection between infrastructure and the local landscape that surrounds that infrastructure. The example of roadside sites is frequently used, where the corridor itself is a response to a regional condition while the specific site can respond to both the corridor and the characteristics of the surrounding landscape. Bohemen's fusion of ecology and art within the realm of infrastructure is ambitious but unfortunately not clearly outlined in the article. Linda Pollak's "The Landscape for Urban Reclamation" skews infrastructure in a similar manner as Stan Allen.[107] Pollak argues that infrastructure should not be seen as an object that occupies space. Instead, infrastructure should be seen as a series of otherwise unused spaces that can be designed or leveraged to improve conditions of the surrounding area. (This argument can be tied to contemporary discussions in the profession regarding the re-use of industrial spaces.) These spaces arise, primarily, from spaces that are ignored by existing objects of infrastructure. Pollak makes the case that existing infrastructure can be analyzed to find left over space, evoking Ignasi Solá-Morales' concept of *terrain vague.*[108] These sites present a difficult situation because of their compromised location, but Pollak notes how a multi-scale approach—i.e., dealing with them individually, as a system, and in relation to their surroundings—to these spatially heterogeneous sites gives designers the opportunity to overcome these difficulties.[109] Pollak's argument includes the discussion of sites that are situated in the context of existing infrastructure but there is no discussion of the specifics of sites along one corridor or within one city. These sites remain abstract.

Although the article proposes a strong and relevant idea to the discussion of infrastructure, it does not provide solid examples to illustrate theory.

The Mesh Book: Landscape/Infrastructure, a publication developed from a 2001 conference at Royal Melbourne Institute of Technology University in Melbourne, Australia with the topic of infrastructure, provides a platform for multiple authors to continue expanding the definition and concept of infrastructure.[110] The publication's introduction, written by Julian Raxworthy and Jessica Blood, proposes that infrastructure must first be viewed as being a functional element in any design. Only after the requisite function has been satisfied can other uses be considered. Without this function-first approach, Raxworthy and Blood argue infrastructure as a concept ceases to exist. The idea of landscape as infrastructure—i.e., that the land itself is a type of infrastructure that should be utilized for both function and civic amenity—is also proposed, though somewhat muddled by the assertion that it is possible to see "the entire environment as various combinations of landscape, architecture, and infrastructure."[111]

Like any publication that consists of aggregated projects and essays, there is no single vision presented in this publication. The introduction attempts to outline an expansive field of infrastructure and the chapters that follow expand the definition further, well beyond relevance to this review. Select chapters, however, offer thoughts on infrastructure that are relevant. Kathy Poole's "Potentials for Landscape as Infrastructure, Part I" focuses on "utilitarian infrastructure," including dams, transportation routes, and communications networks.[112] For Poole, this is a deliberate shift away from landscape architectures traditional concern with gardens and meaning. After a brief historical review of the role landscape architects have taken in infrastructure, Poole notes that there has been a lack of theory to guide landscape architecture's shift toward infrastructure. The goal of the article is to clearly outline "*specific* strategies through which designers can design infrastructurally—and to do so through specific, concrete case studies."[113] Poole calls these strategies "degrees." The first degree is "beautiful coexistence with municipal infrastructure,"[114] where the content provided by a landscape architect and the function provided by an engineer improve each other without merging into a single design gesture. This is, however, a collaborative approach based on a concurrent design and planning process, not landscape as decoration or screen for infrastructure. The second degree is "poetic integration of Function and Aesthetic Experience."[115] Poole argues that in this case the work of an engineer and the work of a landscape architect exist as a single experience and often form. The function of the infrastructure is inhabitable, seen, or even appreciated by visitors. The third degree is "appearance of function and employing the content of utilitarian infrastructure."[116] Projects listed in this degree are not functioning infrastructure. Instead, they are projects that utilize the objects, artifacts, and conditions of infrastructure toward a design concept. Poole argues that these projects should be considered infrastructure since they highlight infrastructure rather than attempting to hide it. The fourth degree is "social infrastructure."[117] Looking beyond municipal works, Poole presents this degree in order to allow infrastructure to support "people and their activities."[118] While acknowledging that the social aspects of landscape have always been a concern of landscape architecture, Poole cites examples that use spaces—one based on a grid, the other based on a buried stream—to illustrate how a social armature can be established in a neighborhood to facilitate social connections. The fifth degree is "fiscal infrastructure," where landscapes generate money for the surrounding community or improve the economic condition.[119] Poole specifically excludes schemes meant to make a profit for investors. Rather, she considers projects that are "catalytic" and have influence beyond their boundaries to fall within this degree.[120] The sixth degree is "formal infrastructure," where a designed, multi-functional landscape structure organizes and improves adjacent spaces.[121] Degree six-and-a-half, which Poole relates to degree five, is a plea for landscape architects to respect and utilize the history of a site in designs. While toward the later degrees Poole begins to stray from the clarity that the degrees were meant to provide, she then adds the comment that infrastructure as designed by landscape architects might include the functions of the typical municipal works—but it also might not; there is a potential that landscape architects have the opportunity to conceive of new types and scopes of infrastructure. In a way, this reiterates a concern that was raised in the 1984 article "A Conceptual Framework for Thinking about Urban Infrastructure" (mentioned above) that called for new types of infrastructure to better meet contemporary needs.[122] Poole concludes with three attributes that she draws from all 6.5 degrees: 1) the influence of infrastructural landscapes extends beyond the boundaries of a single site; 2) infrastructural landscapes engage with natural systems in an often functional manner; 3) infrastructural landscapes influence the experience of visitors.[123]

Walter Hood's "Landscape as Social Infrastructure" takes a more specific approach to infrastructure than Poole, focusing specifically on how remnant spaces in existing infrastructure might contribute to the social well being of a city.[124] Hood's language is deliberately spatial. With the concept of how this type of space can improve the surrounding neighborhood, Hood presents specific examples of how these sites integrate with the surrounding urban fabric. While his arguments for this study are very similar to Pollak's in "The Landscape for Urban Reclamation," Hood provides the spatial and site specificity that was missing in Pollak's article. Toward this, Hood establishes four spatial metaphors: scraping, weaving, stratifying, and lumping; each is illustrated with a specific design case study. Hood's approach is strong and the examples provide necessary context. Unfortunately, all of Hood's examples are at the site scale, which excludes any discussion of how leftover spaces aggregate into a larger-scale intervention. Fortunately, in a later essay, "Territorial Infrastructure," Chris Sawyer addresses the territorial-scale, although in a specifically Australian context.[125] Sawyer's discussions of scale, of infrastructure as "more a procedure than a form,"[126] and of confronting the pictorial focus of much landscape-oriented infrastructure, however, undercuts the value of many of Hood's examples.

In contrast to *Mesh*, Alan Berger in *Drosscape: Wasting Land in Urban America* provides one of the few more specifically spatial responses to infrastructure and infrastructure corridors.[127] Berger focuses on the "wasted" space in the urban zones of the United States, with a focus on the liminal sites that are often unseen. He approaches these sites through aerial photographs, using these documents to generate a discussion about the extent of these sites. More specifically, a section of the book deals with "waste landscapes of infrastructure,"[128] and outlines (briefly) a selection of infrastructure corridors and the types of spaces created, or wasted, as the corridors slice through the surrounding landscape.

From statements in multiple essays in *Mesh* and in Pollak's "Landscape for Urban Reclamation" it is clear that changing notions of infrastructure are closely associated with the rise of landscape urbanism and landscape architecture's embrace of landscape theory. While I will not comprehensively examine the aims and concepts associated with landscape urbanism,[129] I will briefly examine *The Landscape Urbanism Reader,* a seminal publication in the landscape urbanism movement.[130] Although infrastructure and references to infrastructural landscapes appear throughout the book—confirming infrastructure's entry into the landscape architecture lexicon—a few examples from *The Reader* will provide an understanding of the primary points of landscape urbanism that are relevant to this review and that were carried forward into later texts written about infrastructure. In the introduction, Charles Waldheim notes how landscape urbanism addresses the horizontal nature of urbanism in North America and presents opportunities for the creation of urban form "in the context of complex natural environments, post-industrial sites, and public infrastructure."[131] James Corner in "Terra Fluxus" notes how selected nineteenth century landscape projects—he mentions Boston's Bay Bay Fens—embody infrastructural principles of landscape urbanism.[132] Among these principles, Corner mentions working at multiple scales, designing with natural processes, and situating projects within a functional ecologic context. In "Landscapes of Infrastructure," Elizabeth Mossop offers a brief historical survey of landscape and infrastructure before turning toward a more projective, theoretical approach that examines methods for designers to engage with infrastructure. Mossop notes the importance of all sites within cities and near existing infrastructure, mentioning that typically ignored sites are of great value to designers, especially when the design also engages with ecological processes or with the surrounding urban fabric. Addressing highways, Mossop specifically notes that relationships between existing road structures and the surrounding landscape are often lacking. By making these connections, she argues, designers have the potential to re-purpose single-use infrastructure into a vital component of landscape. Jacqueline Tatom then builds on this discussion by offering more specifics on how designers might engage with the design of roadways.[133] Chris Reed appropriately concludes the book with an overview of the implementation, construction, and representation of large-scale infrastructure projects in the twentieth century.[134] Reed's conclusion consists of four "departure points" gleaned from his historical survey: 1)"Blurring of distinctions between traditional fields of practice;" 2) "Appropriation of infrastructural strategies and ecological tactics for new civic programs;"[135] 3) Activation of multiple, overlapping networks and dynamic coalitions of constituencies;" 4) Catalytic and responsive operations." To Reed, these points represent the path forward for designers to engage with infrastructure through the practice of landscape urbanism.

The Landscape Urbanism Reader is an appropriate conclusion for this section, and as a structural hinge in this review, as it codified theoretical ideas regarding landscape and infrastructure, and dispersed them throughout the academic discipline of landscape architecture—resulting in an abundance of essays that address infrastructure between 2006 and 2014. If the *Reader* can be seen as distillation of earlier writings on infrastructure—where a broad section of theory is reduced but also naturalized—these post-*Reader* essays are a re-expansion of ideas of infrastructure, where the ideas proposed in the *Reader* are selected and applied to a variety of situations and research.

A digression, both in topic and time, is necessary to discuss road ecology, specifically Richard T.T. Forman's involvement in road ecology following the publication of *Land Mosaics: The Ecology of Landscapes and Regions* in 1995.[136] This field reflects a movement of some ecologists toward including roads within landscape-scale ecological studies, with landscape ecology providing the spatial language to describe the influence of roads within the surrounding landscape. There is, however, little concern from most ecologists for how their research could have an effect on the design of landscapes. As an exception, Forman published many of his contributions of this field while a professor at Harvard in the Graduate School of Design and had an interest in seeing his research applied to landscape designs.

In "Roads and their Major Ecological Effects" Forman and Lauren E. Alexander establish the importance of studying the effects of roads on landscape pattern and the health of local wildlife.[137] They attempt to redefine the concept of a road corridor, including, beyond the surface of the road, the median, adjacent maintained areas, and any buffer zones. This is a return to the idea of a road as a collection of sites, not only a linear corridor. From this perspective, Forman and Alexander discuss how the local ecology interacts with the conditions of the highway corridor—which often have a negative effect, including air, sound, and light pollution. Roads are also viewed as a major element in the pattern of landscape, changing the way animals move from area to area and often creating barriers that cannot be crossed. In an 1998 editorial titled "Road Ecology: A Solution for the Giant Embracing us," Forman critiques ecologists for not accepting roads as an appropriate realm of study, even though roads occupy and influence such a large percentage of any landscape.[138] He issues a specific call for an interdisciplinary approach to road ecology in an attempt to define a new research field that includes ecologists as well as biologists, planners, and landscape architects. By viewing roads in a wider landscape context, he argues, both ecological benefits and safety improvements for road users can be created. Forman also states that he wishes to "see" the results of his road ecology research in the landscape through the implemented work of designers and planners.[139] *Road Ecology: Science and Solutions* is viewed as the founding document of road ecology. Forman is the lead author, along with 13 other ecologists, engineers, transportation planners, biologists, designers, policy researchers, anthropologists, and hydrologists.[140] The book primarily repeats and expands on ideas raised in earlier articles by Forman. However, the book concludes with a section on road systems. This portion moves beyond road ecology as the study of a single section of road (or single site along a road), shifting into studying how topography and land-use influence networks of roads and how networks of roads influence ecological conditions over large spatial scales. Network theory, used in both transportation planning and ecology, is proposed as a valuable model for road ecology. Specifically, there is an interest in how "network attributes," which can otherwise be seen as sites along roads, aggregate at the scale of a system to influence landscape pattern.[141] Continuing this discussion, the book presents a diagram that notes the variability in the adjacent spaces that a road influences is particularly relevant to this review: movement on the corridor is linear, in response to the engineered efficiency of the road surface; the effects of the road move perpendicularly to the sides of this road surface based on the topography, soil, land-use, micro climate, and hydrology of the surrounding landscape.[142] This is later elaborated at a larger scale through a diagram that begins to depict the spatial influence of a highway.[143] How stream corridors intersect with highway corridors—and the importance of these nodes—is briefly discussed but is unfortunately not extended to include the influence of human-created systems intersecting with highways—e.g., an area of center pivot irrigation with a highway slicing through the middle.

Following this publication—which so clearly and completely elucidates the potentials and necessity of road ecology—Forman's writings on road ecology turn toward his goal of influencing the actions of designers and planners. "Road Ecology's Promise: What's Around the Bed?" presents planners with a simplified outline of the ideas from *Road Ecology*.[144] Issues of roadside vegetation management and wildlife overpasses are given particular attention. "Roadside Redesigns: Woody and Variegated to Help Sustain Nature and People" is a more direct and specific article, offering two concepts for designers to take to improve vegetation along roadsides: woody roadsides and variegated roadsides.[145] Toward woody roadsides, Forman considers the potentials of planting various species in various diameters along roads in order to create social, ecological, and safety improvements. Various precedents studies are discussed, illustrating the potentials for roadside design. Forman considers the various contexts along a roadway and how those contexts might influence what type of woody vegetation is appropriate to plant. Toward variegated roadsides, Forman mentions how heterogeneous vegetation patterns along highways could be both visually pleasing to motorists and improve the ecological quality of roadside areas. While Forman's specific recommendations do much to connect road ecology research to potential landscape interventions, he includes no thorough spatial study or examples; there is no study, even on twenty miles of roadside, of the sites that are available to accommodate woody and variegated patches of vegetation. (Although beyond the time range of this section, in 2012 Forman connects many of these same themes and concepts directly to infrastructure projects and infrastructure corridors in a chapter titled "Infrastructure and Nature: Reciprocal Effects and Patterns for our Future."[146])

Post-*Landscape Urbanism Reader* Rise of Infrastructure (2006 - 2014)

While the publication of *The Landscape Urbanism Reader* provides a convenient—and justifiable[147]—hinge through which to review texts on infrastructure, the period of 2006-2014 also saw the reemergence of popular debates in the United States regarding infrastructure. Part of this discussion was a continuation of the never-addressed infrastructure crisis of the late-twentieth century;[148] part of this discussion was the growth of new types of infrastructure (high-speed rail, primarily) in Europe and Asia, along with writers placing the current state of infrastructure in the United States in a global context.[149] Most of these texts are more concerned with financing, policy making, and construction rather than design. However, "Rethinking the Interstate" by Karrie Jacobs is an exception; the article mentions, although only briefly, how existing infrastructure corridors are a zone of the landscape that contains a tremendous amount of space and that the potential for multiple uses of these corridors has not been adequately researched. The majority of this broader discussion about infrastructure is not relevant to this review, though it does indicate a continued interest in the United States (and much of the Western world) with issues of infrastructure—a point bolstered, even if only rhetorically, by President Barack Obama's 2015 State of the Union Address in which he mentioned the need for a national infrastructure bill incorporating energy and transportation improvements and developments.

Since during this period the literature of infrastructure in the spatial design fields rapidly expanded and diversified, it is difficult to trace any cohesive pattern or lineage. This literature is further complicated because it contains the echo of late-twentieth and early twenty-first century built landscape designs that were consciously infrastructural or post-infrastructural (e.g., abandoned railroads). This corpus of built work, however, provided the opportunity for a number of texts that attempt to glean advice and insights into future infrastructure projects through the analysis of already built projects. This is a category of analysis that was largely absent following the 1960s publication of *View From the Road* and *Freeways.*

The writings of Kelly Shannon and Marcel Smets typify this category. In *The Landscape of Contemporary Infrastructure*, billed as a global overview of infrastructure, Shannon and Smets profile dozens of built works, arranging them in four categories: "Imprints of Mobility on the Landscapes," "Physical Presence in the Landscape," The Perception of Landscape Through Movement," "Infrastructure as Public Space."[150] Each of these categories is then further subdivided into groups of 4-5 built projects. Each of these subcategories is prefaced with an introductory essay in which Shannon and Smets outline the characteristics of opportunities that the subcategory presents. The overall argument is for a cohesive approach to infrastructure, both through interdisciplinary design and through detailed attention to the spaces that infrastructure creates, abandons, and overshadows. Each section reveals a small-scale spatial study of a project, though these spatial studies all remain at the site scale. The local situation, both social and spatial, is considered a top priority in designing new infrastructures or modifying existing projects. In a 2011 article in *Topos*, "Toward Integrating Infrastructure and Landscape," Shannon and Smets offer a more concise and focused—and more landscape oriented—exposition of their infrastructure theory.[151] While this article's method remains a survey of built works, the selected examples are prefaced by an argument for the importance of the "territorial dimension of infrastructure."[152] Natural systems and infrastructure must be considered together, Shannon and Smets argue.

In "Leveraging Infrastructure as Open Space," Jay Hicks argues for the multi-use of open spaces as functional elements within an infrastructural landscape.[153] The focus is specifically on corridors—of natural systems, transportation systems, and hybrids of both. These spaces, Hicks states, must not only be physically integrated but also aesthetically integrated into the surrounding landscape. Building on this, Hicks then hints that blurring the boundaries between typically contentious functional elements of infrastructure and typically welcomed (even if the specific design/program is contentious) recreational elements creates the conditions for improved community response to initial plans. Of particular note, because of its city-scale, is Hick's case study of Atlanta's BeltLine Plan, a proposal that leverages 22 miles of rail corridors into trails to connect the city.[154] Further, Hicks illustrates this case study with an aerial diagram that depicts how different sites along the corridors interact with various types of sites. This is depicted in a single color diagram overlaid on a satellite photograph. In a slightly different approach, in "Ecological Infrastructure" Christopher Benosky and Shaun O'Rourke draw a distinction between gray and green infrastructure.[155] Most of the article is a series of case studies where the specific process of design and construction of each project is discussed. This portion of the article is inherently spatial and allows a reader to grasp the potential of these sites as well as others. Unfortunately, the spatial aspects of the article are never fully addressed by the authors. Taking yet another different approach, a series of case studies presented in *Infrastructural Urbanism: Addressing the In-between* offers a more in-depth method that involves the social reception and the visual impact of existing infrastructure projects.[156] The use of historical research and photographs to illustrate the case studies allows a reader to form a much stronger connection with the text as compared to the projective renderings that typically accompany articles addressing infrastructure.

Although still based on examples of built works, *Next Generation Infrastructure: Principles for Post-Industrial Public Works* by Hillary Brown presents a much more direct and heavy-handed guidance for infrastructure projects.[157] Brown's advice, offered in a series of chapters that address either a type of infrastructure of a theoretical concern in the planning of infrastructure, focuses on the construction of new infrastructure or upgrading existing infrastructure, primarily infrastructural objects; in many ways Brown channels the infrastructure literature of the past few decades into a type of textbook that provides guidance to a designer. Throughout the book, Brown establishes that a systems approach with multi-functional spaces is often the best method to design infrastructure. These systems must also work within their natural and social context.[158]

There are also examples of firms, designers, or firm-sponsored research initiatives using case studies to offer other designers insight into the creation of infrastructure. *Landscape Infrastructure: Case Studies by SWA* presents a series of case studies that examine projects designed or proposed by SWA.[159] Although the scale and site of the cases varies greatly, a number of cases—e.g., Buffalo Bayou Promenade and Kyung-Chun Close Railway Renovation—present spatial studies of corridors that are relevant to this review, though the studies remain at the site scale. While methods used in these studies are broad, most rely on the elucidation of spatial conditions through an aerial view that is often simplified or abstracted in order to better convey a specific condition. Intermixed with the case studies are brief essays by landscape theoreticians and designers. All suggest influence by previous discussions of landscape and infrastructure related to landscape urbanism. "Landscape Infrastructure: Systems of Contingency, Flexibility, and Adaptability" by Ying-Yu Hung, however, offers a connection between landscape urbanism, landscape ecology, and landscape infrastructure.[160] Hung first establishes that landscape urbanism offered an approach to the "spaces in between" an urban fabric.[161] Moving forward, Hung offers a definition of landscape infrastructure based on four principles. The first principle, performance, states that infrastructure set within landscapes can be functional element that can "achieve measurable results," even if landscape has previously been separated from specific measureable specifications.[162] Hung cites the abundance of green roofs in Chicago as an example of landscape performance that can meet established metrics. Building performance, the second principle, aggregate, proposes to see piecemeal interventions in a landscape as a whole. Coordination, Hung argues, is key. The third principle, network, argues for infrastructure as a "connective tissue" in landscape.[163] Hung mentions the example of highways in the United States as a network that has the potential to be leveraged, due to its already established connectivity, through the field of landscape infrastructure. The final principle, increment, is an argument for stepped phasing of infrastructure projects. Instead of the dominant model of public works that involves infrastructure creation as a single event, Hung argues for more ambitious projects that take a longer duration to establish, allowing new methods to be tried and to allow projects to adapt to changing social and ecological contexts.

Three additional texts require a brief discussion: *Infrastructure as Architecture: Designing Composite Networks* by Katrina Stoll and Scott Lloyd, *Islands and Atolls* by Luis Callejas, and *Coupling: Strategies for Infrastructural Opportunism* by Infranet Lab / Lateral Office.[164] All three books offer projective looks at what infrastructure has the potential to become. Although all are somewhat unrealistic in scale, scope, and available technology, each offers an application—even if utopian—of prevailing notions of landscape urbanism and landscape infrastructure to real world problems. These books move beyond theoretical discussions into potential landscape futures. More specifically, the projects presented in these books typically address, in a compelling and coherent manner, regional-scale landscape and infrastructure issues. Examples of specifics at this scale are rare in the infrastructure literature, as projects tend to be either site-scale design or abstract systems. These books present the regional scale within spatial specifics, however.

In seeking perspective on future infrastructure projects and proposals, a second group of writers examines the history of infrastructural landscape interventions, searching for patterns and processes that have influenced, ruined, or bolstered past infrastructure projects.[165] There is a focus in this literature on looking at infrastructure theories and paradigms through time. Social and technological context is key. Antoine Picon briefly traces the rise and evolution of infrastructure in western Europe to suggest that soon there will be "a spectacular inversion of the relations between urban infrastructure and the natural milieu."[166] *Infrastructural Urbanism* contains three studies of this type.[167]

Carlotta Daro's "Wired Landscapes: Infrastructures of Telecommunication and Modern Urban Theories," by discussing the implementation of vast networks of wired and wireless communications during the early twentieth century in relation to urban theory, presents a number of encapsulated infrastructure processes, offering a glimpse at how a specific technology is viewed and designed during its lifespan.[168] Maarten Van Acker in "Re-tracing the Ringscape—Infrastructure as a Mode of Urban Design," presents a historical case study of Antwerp to investigate how the design and construction of infrastructure has been crucial to large-scale urban design.[169] Of particular note is Van Acker's argument that a long-term infrastructure project designed and re-designed with changing scales and types of technology also created a variety of spaces that are leftover fragments from the design process. In a way, Van Acker is using a landscape history, conveyed through spatial diagrams, to locate points of potential intervention within an infrastructure project. Related to this historical study, Matteo D'Amros and Roberto Zancan in "Infrastructure's Marginal Spaces and the Invention of a Prosaic Landscape—Visual Knowledge and Design" trace the perception of the interstitial spaces of infrastructure through the history of visual art.[170] D'Amros and Zancan propose that how these spaces have been represented historically provides an important starting point for designers seeking to propose an alternate future for marginal spaces along infrastructure projects, especially corridors such as highways.

Pierre Bélanger, one of the most prominent and prolific writers on infrastructure in landscape architecture, presents a more wide-ranging and thus synthesizing approach to infrastructure history, taking a disciplinary stance between environmental history, geography, and landscape architecture. His three most well known articles are addressed here in chronologic order, as each article builds on the previous (with some repetition) toward Bélanger's effort to redefine infrastructure. In these articles, history is used only in fragments of case studies; no in-depth studies are presented. "Landscape as Infrastructure" surveys twentieth century, primarily Rust Belt, infrastructures in North America by looking at the categories of "Failures & Accidents," "Shifts & Patterns," and "Streams & Synergies," each illustrated with specific examples.[171] These section titles outline Bélanger's focus for redefining infrastructure and are recurrent themes in all three articles. The studies presented within these categories—among them, the Love Canal in Niagara Falls, New York—lead Bélanger to propose a new definition of infrastructure that is regional, that addresses the inevitability of globalization, and that embraces artificial ecologies, including ecologies that deal with waste and pollution. His infrastructural vision is strongly ecological, with the inclusion of anthropomorphic material flows, and encourages designers to work at both large and small spatial and temporal scales simultaneously. These ideas are consciously built on the tenets of landscape urbanism—an influence that Bélanger readily acknowledges. "Redefining Infrastructure," while continuing Bélanger's call for landscape as infrastructure, again traces twentieth century infrastructure in the United States through a series of brief case studies.[172] In his chosen examples—Prairie States Forestry Project and Euclidean Zoning, for example—the focus is on the regional scale, toward which Bélanger argues for infrastructure to aspire. Within this larger scale, he is calling for a more flexible infrastructure that grants significance to material and energy flows, not only static form. An expansive ecology that includes industrial processes is, again, incorporated. Bélanger's turn toward leveraging regional industrial and ecological processes within infrastructure is continued in "Landscape Infrastructure: Urbanism Beyond Engineering."[173] Representation becomes key to his argument. Many of these large-scale processes are not visible while standing in one location—i.e., they cannot (or cannot accurately) be captured in a single photograph. Bélanger uses the phrase "infrastructural ecologies" to discuss these processes. All of Bélanger's work makes the argument that infrastructure at the regional scale is not a novel concept, and that landscape architects have much to learn by studying the history of infrastructure. Although because of this focus his work cannot be viewed as ahistorical, it lacks the depth and rigor of more traditional historical essays. The trade off is, of course, that the synthesizing approach of Bélanger offers a wider perspective on infrastructure as compared to a historical study.[174]

A third category of writers address infrastructure by looking at a combination of specific built works, historical context, and theoretical context with a focus on reception and experience of post-infrastructural sites.[175] Since this literature is beyond the scope of this review, I mention it here only as a direction for important future research into infrastructure. This type of research could also be applied to active infrastructure sites, as how a community (or culture) receives an infrastructure project has implications on how (and if) that project is maintained and funded.

During the time period discussed in this section, a body of infrastructure literature expanded upon the tenets of landscape urbanism toward new visions of form, time, and space in infrastructure. Many of the texts placed in this category show a clear alignment with boilerplate landscape urbanism conceptions of landscape and infrastructure. However, each text offers a new idea, even if briefly stated. Pierluigi Nicolin in

“Landscapes and Infrastructures” applies ideas of entropy to infrastructure, a process typically ignored while discussing infrastructure design.[176] It is necessary to move beyond the perspective of endless, almost utopian, materialism, Nicolin argues, before then questioning how we perceive landscape and how representation differs from reality affects infrastructure design. Giacomo Delbene’s “Hybridize! Rules of Engagement for Landscape and Infrastructure” directly addresses the notion of infrastructure and multiple scales.[177] Delbene argues that over the territorial scale individual spaces aggregate into “sequence, system, [a] maelstrom of heterogeneous range of localized habitats and systems….”[178] Because of this condition, infrastructure thus provides an opportunity for hybrids that juxtapose the local and the infrastructural. While this is not a novel concept in the literature of infrastructure, Delbene’s focus on the aggregation of many local sites over the scale of a territorial infrastructure is important. Rahul Paul in “From Object Line to Vector Field—The Social Instrument” argues for infrastructure as an “operational field.”[179] More importantly to this review, however, Paul inserts Kenneth Frampton’s notion of Critical Regionalism to the infrastructure debate, arguing that Frampton’s concern with acknowledging the local without eschewing the global forefronts the role of landscape, both physically and socially, within an infrastructure project. Federico Parolotto in “Reversible Infrastructure” acknowledges the importance of temporal scales and temporal variation in the form of infrastructure.[180] Although focusing on connectivity that can be achieved in the urban fabric, Parolotto’s argument that the future of infrastructure will be in less permanent, more easily changed infrastructure interventions is directly applicable to this review. What emerges in these texts is the continuing study of infrastructure as landscape, with additional aspects and concepts proposed.

Infrastructure remains an active—and certainly not exhausted—field of writing for the spatial design fields. However, it is also apparent that many of the main tenets of infrastructure in the spatial design fields have been repeatedly outlined within the past 70 years.

Toward building on the tenets of landscape urbanism and addressing the leftover spaces that surrounding infrastructure, a body of texts examines the spatial patterns that remain after infrastructure construction or abandonment. Each of these two processes interacts with the landscape in different ways to form a series of sites along infrastructure projects, especially corridors. In a way, discussion of these marginal spaces is a return to early discussions of *terrain vague*. But discussion of these spaces expanded in the years following the rise of landscape urbanism, giving this newer round of texts a more refined approach to these spaces.[181]

"Urban Landscape: Interstitial Spaces" by Rute Sousa Matos studies Portuguese cities for insights into the nature of forgotten fragments of the urban fabric.[182] Many of these spaces are formed through the introduction of infrastructure that creates barriers or voids in the urban fabric. Matos states that these spaces do not have an accepted name and are thus sometimes lumped into the generic category of "green space." This lack of specific definition and name causes these spaces to be often ignored in officially sanctioned design. By tracing the characteristics of these sites from the urban core to the periphery, Matos establishes that the sites are a response to the prevailing surrounding conditions and sees the potential in aggregating these forgotten spaces into a landscape strategy to help form local identity. Matos argues that most interstitial sites are in contentious areas—"natural tensions"—and are therefore difficult sites to design.[183]

However, they are essential to healthy cities and to bind together disconnected urban fabric. *Infrastructural Urbanism* contains three chapters that each examines different aspects of these urban interstitial spaces in relation to infrastructure: "Occupying the Edge and the Underneath—Other Urban Public Spaces," "As Found. Use, Meaning, and Re-appropriation of contentious Urban Spaces," and "Infrastructural Form, Interstitial Spaces and Informal Acts."[184] All of the chapters are in agreement that these interstitial spaces lack an accepted name and can therefore be seen as unofficial spaces. All also argue that these spaces are ideal places for informal occupations or programs that can vary over time according to constraints imposed by the site and the needs of different groups from the surrounding communities. Ed Wall in "Infrastructural Form" notes that the abandoned character of these spaces is often heightened by their proximity to efficiently engineered and maintained infrastructural spaces. These articles are valuable for this review because they begin to suggest the spatial and social conditions of interstitial spaces surrounding infrastructure. However, these articles all examine examples in urban environments, where there is a nearby, dense population to colonize the sites.

A different vein of this literature—one that is highly relevant to this review—looks more specifically at the interstitial spaces created by infrastructure corridors. Both articles discussed here examine post-infrastructural sites. However, the methods and analysis that both articles provide are valuable for any study of infrastructure.

In "Thin Parks / Thick Edges: Towards a Linear Park Typology for (Post)Infrastructural Sites," Karl Kullmann provides a detailed analysis of the spatial characteristics of parks built on former infrastructure corridors.[185] This analysis is prefaced by a discussion about how edges are a dynamic location in a landscape, whether discussing a meadow ecosystem or an urban ecosystem; at the edge, movement and activity is concentrated. Kullman notes that any type of break in a fabric—topographic, social, infrastructural—can create an edge, and that an edge can become *terrain vague* if it does not have a strong inherent force of identity, such as a shoreline or an imposing cliff. Following Kullman's argument, most edges created by infrastructure have either no identity or a negative identity. These edges, however, must not be viewed as only lines of movement. Instead, as the article's title suggests, all edges have a thickness, through the spatial arrangement of the line itself or through its influence on the surrounding landscape. Most edges in urban areas, according to Kullman, are "the by-product of a plethora of cultural processes and needs…."[186] By acknowledging this complexity in his analysis, Kullman introduces spatial landscape history into the study of linear landscapes. Kullman's method first involves scale figure / ground diagrams of twenty built examples of linear parks. In these diagrams, the linear space is the figure, an inversion of the typical figure / ground distinction.[187] From these diagrams, Kullman refines a series of typologies that reveals the potentials that designers might have when designing, planning, or scouting the urban landscape for potential linear parks. This advice is conveyed through a list of 19 linear park characteristics, each with a descriptive paragraph, and a list of the seven typologies, also with a descriptive paragraph. The combination of both text description and diagrammatic description presents a strong and easily understood argument useful in analyzing any type of spatial condition related to corridors or other types of linear landscape. Unfortunately, photographs of the studied sites are not present in the article.

With a different method and analysis, Mattias Qviström in "Network Ruins and Green Structure: An Attempt to Trace Relational Spaces of a Railway Ruin" presents a historical and spatial study of a 35 km stretch of the BLHJ Railway near Lund, Sweden.[188] This specific case allows Qviström to offer more historical context than Kullman, though the focus on a single case also removes the comparative element of Kullman's study. Qviström seeks to elucidate an example of the concept of a network ruin through the use of the BLHJ case study. Instead of viewing the now abandoned BLHJ rail corridor as a single line through the landscape, a ruin, Qviström sees the corridor as system of heterogeneous, interconnected ruins, all related to the former activity of the railway. Because of the variety, this network ruin has the potential to accommodate a variety of programs. Qviström traces the network ruin using historic documents, photographs, and site visits, and then displays his results through a series of maps filled with various icons and connecting corridors. Throughout the discussion of how the corridor is perceived by users before a design change, Qviström establishes that this network ruin should be seen as a "multifunctional *area"* instead of only a line.[189] This awareness of a corridor as an aggregation of sites is essential to Qviström's analysis. Despite the value of both Kullman's and Qviström's studies, both focus on relatively small sites and fail to reckon sufficiently with the regional scale.

Conclusion / Research Direction

In this review, a number of concepts related to landscape have been explored that will be important to any study into infrastructure corridors: 1) infrastructure corridors have a width that varies in response to landscape history and surrounding topography and land use; 2) the influence of infrastructure corridors on the surrounding landscape, both in a single moment and over time, must be acknowledged; 3) because infrastructure corridors are seen from both within the corridor and from outside of the corridor, the experience and appearance of both perspectives must be designed; 4) infrastructure corridors can be considered systems that function at the regional scale; 5) because of this regional influence and agency, infrastructure corridors must be conceptualized in conjunction with the economic processes and material movements that occur on or within the corridor.

Despite this guidance, however, this review has also revealed a number of promising avenues for research: 1) Discussions of infrastructure tend to be either abstract—i.e., theorizing about potential conditions without geographic specifics—or restrained by the scale of a single site. This has created a lack of research into spatial conditions of infrastructure beyond the site scale; 2) Only minimal research—and, again, even less that is spatially specific—that discusses the sites along infrastructure corridors at a regional scale has been conducted; 3) The development of a reliable method for designers to study expansive infrastructure corridors and how to connect those corridors to a region has been given minimal attention.

As mentioned in the introduction, these opportunities have directed this thesis toward developing a method to better understand the sites along an infrastructure corridor at a regional scale and to then apply that method to a selection of case studies in that region, with the goal of proposing a new concept to guide the re-design or repositioning of the landscapes of existing infrastructure corridors.[190]

[1] For a more detailed treatment of this point—and a discussion that compares physical infrastructure (that which requires a connected presence on the ground) with information infrastructure (that requires only nodes reliably connected with telecommunications of some variety), see Paul N. Edwards, "Infrastructure and Modernity: Force, Time, and Social Organization in the History of Sociotechnical Systems," in *Modernity and Technology*, ed. Thomas J. Misa, Philip. Brey, and Andrew. Feenberg (Cambridge, Mass.: MIT Press, 2003), 185–225.

[2] Star, "The Ethnography of Infrastructure." For a similar discussion, though one more focused on ideology and power in infrastructure, see Keller Easterling, *Extrastatecraft: The Power of Infrastructure Space* (London; New York: Verso, 2014).

[3] Historic studies of infrastructure have been written and provide a much more detailed look into the development and ideology of infrastructure (and that of specific types of infrastructure) than is provided in this work. Among many examples, see Antoine Picon, *French architects and engineers in the Age of Enlightenment* (Cambridge [England]; New York, NY, USA: Cambridge University Press, 1992); Tom Lewis, *Divided Highways: Building the Interstate Highways, Transforming American Life* (New York, N.Y.: Viking, 1997); Han Meyer, *City and Port: Urban Planning as a Cultural Venture in London, Barcelona, New York, and Rotterdam : Changing Relations between Public Urban Space and Large-Scale Infrastructure* (Utrecht: International Books, 1999); Tim Culvahouse, *The Tennessee Valley Authority Design and Persuasion* (New York: Princeton Architectural Press, 2007); Christof Mauch and Thomas Zeller, eds., *The World Beyond the Windshield: Roads and Landscapes in the United States and Europe* (Athens, Ohio: Ohio University Press, 2008); Katherine Wentworth Rinne, *The Waters of Rome: Aqueducts, Fountains, and the Birth of the Baroque City*, First Edition edition (New Haven: Yale University Press, 2011); Jo Guldi, *Roads to Power Britain Invents the Infrastructure State* (Cambridge, Mass.: Harvard University Press, 2012).

[4] The sources I have selected are primarily written in or about the United States, for two reasons: 1) Language barrier: many of the early (1960s-1980s) texts about infrastructure in Europe have not been translated into English, especially those written in Dutch, German, and French. 2) The North American content, given its geographic expanse, the relatively late period of European settlement, and the decline of the industrial economy in the Rust Belt offers many superlative examples of infrastructure construction, decay, and reuse, providing ideal examples for case studies and theory explorations.

[5] For example, compare the current situation of the United States with that of China, especially the South-North Water Diversion Project and the High-Speed Rail Network, both currently under construction. David Barboza, "In China, Projects to Make Great Wall Feel Small," *The New York Times*, January 12, 2015, http://www.nytimes.com/2015/01/13/business/international/in-china-projects-to-make-great-wall-feel-small-.html.

[6] *Time Maps: Collective Memory and the Social Shape of the Past* (University of Chicago Press, 2012).

[7] The date of 1973 comes from Rosalind William, who considers this date the end of the major construction phase of the United State's Interstate Highway System. See "Cultural Origins and Environmental Implications of Large Technological Systems," *Science in Context* 6, no. 02 (1993): 394.

[8] Ibid., 393.

[9] Much of the literature on civil engineers is technical or project specific. In contrast, see Earl Swift, *The Big Roads: The Untold Story of the Engineers, Visionaries, and Trailblazers Who Created the American Superhighways*, Reprint edition (Boston: Mariner Books, 2012); Bruce Edsall Seely, *Building the American Highway System: Engineers as Policy Makers* (Philadelphia: Temple University Press, 1987); for a brief overview of railroad landscape design, see John R. Stilgoe, "Garden," in *Metropolitan Corridor: Railroads and the American Scene* (New Haven; London: Yale University Press, 1985), 223–44; for a brief overview of parkway history and design, see Gilmore D. Clarke, "The Parkway Idea," in *The Highway and the Landscape*, ed. William Brewster Snow (New Brunswick, N.J.: Rutgers University Press, 1959), 33–55; Timothy Davis, "The American Motor Parkway," *Studies in the History of Gardens & Designed Landscapes* 25, no. 4 (October 1, 2005): 219–49; Timothy Davis, "The Rise and Decline of the American Parkway," in *The World Beyond the Windshield: Roads and Landscapes in the United States and Europe*,

ed. Christof Mauch and Thomas Zeller (Athens, Ohio: Ohio University Press, 2008), 35–58; Paul Kelsch, "Cultivating Modernity, History, and Nature," *Studies in the History of Gardens & Designed Landscapes* 31, no. 4 (October 1, 2011): 294–310. For a more thorough listing of early texts related to highways and landscape architecture, see Mary Ellen. Huls, *Highway Landscape Architecture: A Bibliography* (Monticello, Ill.: Vance Bibliographies, 1986).

[10] Norman T Newton, *Design on the Land: The Development of Landscape Architecture* (Cambridge, Mass.: Belknap Press of Harvard University Press, 1971), 597.

[11] Admittedly, writing that the emergence of design in infrastructure corridor occurred in the mid-twentieth century overlooks the early development of roads, canals, and railroads—all of which involved engineers designing the land.

[12] Lewis Mumford considered the defense angle a ruse. See Lewis Mumford, *The Highway and the City* (New York: Harcourt, Brace & World, 1963), 234.

[13] See, for example, Tunnard and Pushkarev, *Man-Made America*, 5.

[14] Although not the approach used in this literature review, approaching the idea of infrastructure through the design and construction of specific elements—e.g., ports, roads, inter-modal terminals—might be a fascinating method.

[15] Wayne Scott, "Case History of a Super Highway," *Landscape* 6, no. 2 (Winter 1956): 8–12.

[16] Documents from this early period of construction have the potential to be a starting point for future research into the cultural reception of the interstate highway system.

[17] Desmond Hennessey, "Motor Roads in the Modern Landscape," *Architectural Design* 26 (1956): 275–79.

[18] Ibid., 278–279.

[19] G.A. Jellicoe, "Motorways: Their Landscaping, Design and Appearance," *Journal of the Town Planning Institute* 44, no. 20 (1958): 274–83.

[20] Ibid., 274; 278.

[21] For Jellicoe's other major contribution to the discussion of highways, landscape, and the automobile, see Geoffrey Jellicoe, *Motopia: A Study in the Evolution of Urban Landscape* (New York: Praeger, 1961). In contrast to the experiential and spatial focus of "Motorways," *Motopia* examines the potentials of changing urban form in response to the density of automobile traffic.

[22] William Brewster Snow, *The Highway and the Landscape* (New Brunswick, N.J.: Rutgers University Press, 1959). As mentioned above, this review is not directly addressing the design of parkways. However, it is worth noting that the content of *The Highway and the Landscape* (and the biographies of a few writers) reflect a connection to that earlier period.

[23] Ibid., xii.

[24] F.W. Cron, "The Art of Fitting the Highway to the Landscape," in *The Highway and the Landscape*, ed. William Brewster Snow (New Brunswick, N.J.: Rutgers University Press, 1959), 78–109.

[25] Ibid., 85.

[26] Ibid., 109.

[27] Wallace A. Johnson, "Preserving the Scenic Qualities of the Roadside," in *The Highway and the Landscape*, ed. William Brewster Snow (New Brunswick, N.J.: Rutgers University Press, 1959), 110–30.

[28] B.E.F., "Highways as Scenery," *Landscape* 12, no. 2 (Winter 1962): 23–24.

[29] Pushkarev, "The Esthetics of Freeway Design."

[30] Ibid., 7.

[31] Ibid., 14.

[32] Ibid., 15.

[33] Brian J. L. Berry and William L. Garrison, "Cities and Freeways," *Landscape* 10, no. 3 (Spring 1961): 20–25. This article is a summary of the studies that Garrison gathered in *Studies of Highway Development and Geographic Change* (Seattle: University of Washington Press, 1959).

[34] Berry and Garrison, "Cities and Freeways," 20.

[35] Ibid.

[36] See Eugene P. Odum and Howard T. Odum, *Fundamentals of Ecology* (Philadelphia & London: W.B. Saunders Co., 1959). Also, later in this review I will examine how the work of prominent landscape ecologists potentially had an influence on landscape architects writing about infrastructure in the 1990s and later.

[37] Mumford, *The Highway and the City*, 234.

[38] See, for example, Swift, *The Big Roads*, 227–255.

[39] Tunnard and Pushkarev, *Man-Made America*. See p. xi for a note that states Pushkarev was responsible for the section of the book devoted to highways and highway design.

[40] See p. 157 of *Man-Made America* for an outline of these chapters.

[41] Tunnard and Pushkarev, *Man-Made America*, 170.

[42] See the diagram on Ibid., 187.

[43] Ibid., 201.

[44] "Natural rock strata are always to be considered and used to the best visual advantage in rock cuts. Exposed rock formations give the driver the same sense of reality and permanence that exposed structure can give the observer of architecture. Besides, driving through a succession of rock cuts can become that experience of a living geological museum, sharpening a person's awareness of how his planet was built. Rock carefully cut along natural strata and natural faults can bring forth the most exciting sculptural forms, aside from eliminating 'fallen rock zones.' In finishing such rock cuts, the contractor with the pneumatic drill should be assisted by an expert geologist and a sculptor." Ibid., 210.

[45] Ibid., 220.

[46] Donald Appleyard, Kevin Lynch, and John R. Myer, *The View from the Road* (Cambridge: Published for the Joint Center for Urban Studies of the Massachusetts Institute of Technology and Harvard University by the M.I.T. Press, 1964); Lawrence. Halprin, *Freeways* (New York: Reinhold Pub. Corp., 1966).

[47] See Kevin Lynch, *The Image of the City* (Cambridge, Mass.: MIT Press, 1960). Highways appear sporadically through *The Image of the city*, especially during interviews with residents. However, no extensive treatment of designing highway form or experience is offered. *The View from the Road*, then, offers a continuation of Lynch's original work.

[48] Appleyard, Lynch, and Myer, *The View from the Road*, 63.

[49] Halprin, *Freeways*, 5.

[50] Ibid., 17.

[51] Ibid., 23.

[52] Ibid., 12.

[53] Ibid., 37.

[54] Ibid., 97.

[55] Ibid., 86. The use of macro and micro is a clear reference to Pushkarev's earlier work.

[56] Urban Advisors to the Federal Highway Administrator (U.S.), *The Freeway in the City: Principles of Planning and Design: A Report to the Secretary, Department of Transportation* (Washington, D.C.: Department of Transportation, 1968).

[57] James C. Scott, *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed* (New Haven: Yale University Press, 1999).

[58] Ian L. McHarg, *Design with Nature* (Garden City, N.Y.: Published for the American Museum of Natural History [by] the Natural History Press, 1969), 31–42.

[59] Ibid., 33–35.

[60] In Denmark, many of these same ideas were applied to roads built during the 1960s. Sources in English are lacking. However, from available sources it seems that the majority of this work was built toward the experience of highway users and that using plantings were used frequently as screens and frames for views. See Annemarie Lund, *Guide to Danish Landscape Architecture, 1000-2003* (Arkitektens Forlag, 2003), 135. C. Th. Sorensen is mentioned in the *Guide* as being at the forefront of this movement in Denmark. Unfortunately, monographs of his work do not give his freeway design work full treatment. See Sven-Ingvar Andersson and Steen Høyer, *C. Th. Soerensen: Landscape Modernist* (Danish Architectural Press, 2001).

[61] The use of the term "rise" is not meant to ignore the role designers of landscape (from many professions) have played in the development of infrastructure since the development of towns and cities. However, since infrastructure was not common until this period, "rise" is used to indicate the emergence of infrastructure as a term that represented an ambiguous array of public works.

[62] David Gobel, "Introduction," *Modulus* 17 (1984): 1.

[63] Robert Bruegmann, "Infrastructure Reconstructed," *Design Quarterly*, no. 158 (Winter 1993): 11.

[64] Gobel, "Introduction," 1.

[65] Ibid.

[66] Pat. Choate and Susan Walter, *America in Ruins: Beyond the Public Works Pork Barrel* (Washington, D.C.: Council of State Planning Agencies, 1981). To some degree, this trend has continued until the present-day, though more recent books are more focused on developing ways to perpetuate the existing system. See Barry B. LePartner, *Too Big to Fail: America's Failing Infrastructure and the Way Forward* (New York: Foster Publishing, 2010); Felix G. Rohatyn, *Bold Endeavors: How Our Government Built America, and Why It Must Rebuild Now* (Simon and Schuster, 2009). In order to trace how quickly the discussion on infrastructure has transitioned from fascination to crisis, it is also worthwhile to look at its mid-century reception when infrastructure was first being noticed. See, for example, Harry Granick, *Underneath New York* (New York, Toronto: Rhinehart & Co., 1947).

[67] John P. Eberhard and Abram B. Bernstein, "A Conceptual Framework for Thinking about Urban Infrastructure," *Built Environment* 10, no. 4 (1984): 253–61.

[68] Ibid., 254.

[69] Marshall Kaplan, "Hard Choices: Responding to America's Infrastructure Problems," *Built Environment* 10, no. 4 (1984): 245–52.

[70] D. Diamond and N. Spend, "Infrastructure and Regional Development: Theories," *Built Environment* 10, no. 4 (1984): 262–69; W.J. Meadows and P.M. Jackson, "Infrastructure and Regional Development: Empirical Findings," *Built Environment* 10, no. 4 (1984): 270–81.

[71] Ralph Gakenheimer, "Infrastructure Shortfall: The Institutional Problems," *Journal of the American Planning Association* 55, no. 1 (1989): 14.

[72] Ibid., 14–15.

[73] Anne Whiston Spirn, *The Granite Garden: Urban Nature and Human Design* (New York: Basic Books, 1984); Michael. Hough, *City Form and Natural Process: Towards a New Urban Vernacular* (New York: Van Nostrand Reinhold, 1984).

[74] For a related discussion of this lineage, see Kathy Poole, "Potentials for Landscape as Infrastructure, Part I: Six-and-a-Half Degrees of Infrastructure," in *The MESH Book: Landscape/infrastructure*, ed. Julian R. Raxworthy and Jessica Blood (RMIT Publishing, 2004).

[75] Bruegmann, "Infrastructure Reconstructed"; Catherine R. Brown and William Morrish, "Toward a New Infrastructure," *Architecture* 82, no. 8 (1993): 35,37,39.

[76] Bruegmann, "Infrastructure Reconstructed," 13.

[77] For example, compare with the more specific (and poetic) approach of Jacques Simon, "The Road as a Line, The Landscape as a Script," *Topos*, no. 15 (1996): 100–106. Both articles elucidate spatial conditions using different methods, goals, and styles.

[78] William R. Morrish and Catherine R. Brown, "Putting Place Back into Infrastructure," *Landscape Architecture* 85, no. 6 (1995): [50] – 53.

[79] Ibid., 52.

[80] Robert L. Thayer, "Increasingly Invisible Infrastructure," *Landscape Architecture* 85, no. 6 (1995): 136.

[81] Robert L. Thayer, *Gray World, Green Heart: Technology, Nature, and Sustainable Landscape* (New York: Wiley, 1994).

[82] Gary L. Strang, "Notes from Underground," *Landscape Architecture* 85, no. 6 (1995): 33–35.

[83] Gary L. Strang, "Infrastructure as Landscape," *Places* 10, no. 3 (July 1, 1996): 8–15.

[84] Rem Koolhaas, "What Ever Happened to Urbanism?," in *S,M,L,XL, OMA* (New York: The Monicelli Press, 1995).

[85] Richard T.T. Forman, *Land Mosaics: The Ecology of Landscapes and Regions* (New York: Cambridge University Press, 1995). See also Wenche E. Dramstad, James D. Olson, and Richard T. T. Forman, *Landscape Ecology Principles in Landscape Architecture and Land-Use Planning* (Washington, DC: Harvard University Graduate School of Design ; Island Press ; American Society of Landscape Architects, 1996).

[86] Forman, *Land Mosaics*, xiii.

[87] Elissa Rosenberg, "Public Works and Public Space: Rethinking the Urban Park," *Journal of Architectural Education* 50, no. 2 (November 1, 1996): 89–103.

[88] Ibid., 89. This argument predates a similar argument made by Elizabeth Meyer, though both Meyer and Rosenberg were at the University of Virginia during this time. See Elizabeth Meyer, "The Expanded Field of Landscape Architecture," in *Ecological Design and Planning* (New York: Wiley, 1997), 45–79.

[89] Kathy Poole, "'Civitas Oecologie': Infrastructure in the Ecological City," *Harvard Architecture Review* 10 (1998): [126] – 145; Marc M. Angélil and Anna Klingmann, "Hybrid Morphologies: Infrastructure, Architecture, Landscape," *Daidalos*, no. 73 (1999): 16–25.

[90] Poole, "Civitas Oecologie," 127.

[91] Angélil and Klingmann, "Hybrid Morphologies," 17.

[92] Ibid., 24.

[93] Poole, "Civitas Oecologie," 127.

[94] Ibid., 135.

[95] Barbara Knecht, "Urban Infrastructure: The 'out of Sight, out of Mind' Mentality Is an Outmoded Concept," *Architectural Record* 190, no. 6 (2002): 151–54,156,158.

[96] Andrea Oppenheimer Dean, “Expressing the Infrastructure: For William Morrish, Potentially Beautiful Infrastructure Connects and Gives Form to Landscapes,” *Landscape Architecture* 93, no. 8 (2003): 92–95.

[97] Ibid., 92.

[98] Alessandro Rocca, “Atlante: Il Nuovo Paesaggio Delle Infrastrutture in Europa = Atlas: The Contemporary Landscape of Europe’s Infrastructures,” *Lotus International*, no. 110 (2001): 126–43.

[99] Ibid., 122.

[100] Stan. Allen, *Points + Lines: Diagrams and Projects for the City* (New York: Princeton Architectural Press, 1999), 48–57.

[101] Ibid., 52.

[102] Ibid., 55.

[103] James Corner, *Recovering Landscape: Essays in Contemporary Landscape Theory* (New York: Princeton Architectural Press, 1999).

[104] Ibid. The link between theory written about infrastructure and its connection to practice and built-works of infrastructure is not examined here, though this has the potential to offer insight into the development of landscape architecture’s interest in infrastructure.

[105] Hein van Bohemen, “Infrastructure, Ecology and Art,” *Landscape and Urban Planning* 59, no. 4 (2002): 187–201.

[106] Ibid., 187;191.

[107] Linda Pollak, “Il Paesaggio per Il Recupero Urbano: Infrastrutture per Uno Spazio Quotidiano Che Comprenda La Natura = Landscape for Urban Reclamation: Infrastructures for the Everyday Space That Includes Nature,” *Lotus International*, no. 128 (2006): [32] – 45.

[108] See Ignasi Solá-Morales, “Terrain Vague,” in *Anyplace*, ed. Cynthia C. Davidson (Cambridge, Mass.: The MIT Press, 1995).

[109] Pollak, “Landscape for Urban Reclamation,” 38.

[110] Julian R. Raxworthy and Jessica Blood, *The MESH Book: Landscape/infrastructure* (RMIT Publishing, 2004).

[111] Ibid., 13.

[112] Poole, “Potentials for Landscape as Infrastructure, Part I: Six-and-a-Half Degrees of Infrastructure,” 19.

[113] Ibid., 21.

[114] Ibid., 22.

[115] Ibid., 24.

[116] Ibid., 26.

[117] Ibid., 28.

[118] Ibid.

[119] Ibid., 32.

[120] Ibid.

[121] Ibid., 35.

[122] Eberhard and Bernstein, “A Conceptual Framework for Thinking about Urban Infrastructure.”

[123] Poole, “Potentials for Landscape as Infrastructure, Part I: Six-and-a-Half Degrees of Infrastructure,” 43.

[124] Walter Hood, “Landscape as Social Infrastructure: Hybrid Modifications—Scraping, Weaving, Stratifying, and Lumping,” in *The MESH Book: Landscape/infrastructure*, ed. Julian R. Raxworthy and Jessica Blood (RMIT Publishing, 2004).

[125] Chris Sawyer, “Territorial Infrastructure,” in *The MESH Book: Landscape/infrastructure*, ed. Julian R. Raxworthy and Jessica Blood (RMIT Publishing, 2004).

[126] Ibid., 275.

[127] Alan Berger, *Drosscape: Wasting Land Urban America* (New York: Princeton Architectural Press, 2007).

[128] Ibid., 170.

[129] For one of the few critical, focused, and yet productive—i.e., not incendiary—reviews of landscape urbanism, see Ian Hamilton Thompson, “Ten Tenets and Six Questions for Landscape Urbanism,” *Landscape Research* 37, no. 1 (February 1, 2012): 7–26. For a perspective on how landscape urbanism evolved in the years following the *Reader* and how it merged or inspired other “modifiers to urbanism,” in the words of Charles Waldheim, see *Topos* 71 (2010).

[130] Charles Waldheim, ed., *The Landscape Urbanism Reader* (New York: Princeton Architectural Press, 2006).

[131] Ibid., 15.

[132] Corner, “Terra Fluxus.”

[133] Tatom, “Urban Highways and the Reluctant Public Realm.”

[134] Chris Reed, “Public Works Practice,” in *The Landscape Urbanism Reader*, ed. Charles Waldheim (New York: Princeton Architectural Press, 2006), 267–85.

[135] Ibid., 281–283.

[136] Forman, *Land Mosaics*. For a review of road ecology literature that, unfortunately, largely ignores efforts to modify existing roads, see Alisa W. Coffin, “From Roadkill to Road Ecology: A Review of the Ecological Effects of Roads,” *Journal of Transport Geography* 15, no. 5 (September 2007): 396–406. Further, in focusing on road ecology, I am excluding the related field of railroad ecology. My reason for this is that railroad ecology tends to be purely botanical in studying the types of plants growing in the ballast along railroad tracks, while road ecology takes a more comprehensive look at spaces surrounding roads and the landscapes that roads cross. However, for a brief overview, see C. Sargent, *Britain’s Railway Vegetation* (Cambridge: Institute of Terrestrial Ecology, 1984).

[137] Richard T.T. Forman and Lauren E. Alexander, “Roads and Their Major Ecological Affects,” *Annual Review of Ecology and Systematics*, 1998, 207–31.

[138] Richard T.T. Forman, “Road Ecology: A Solution for the Giant Embracing Us,” *Landscape Ecology* 13, no. 4 (1998): III – V.

[139] Ibid., iv.

[140] Richard T.T. Forman et al., *Road Ecology: Science and Solutions* (Island Press, 2003).

[141] Ibid., 298.

[142] Ibid., 310.

[143] Ibid., 313.

[144] Richard T.T. Forman, “Road Ecology’s Promise: What’s around the Bend?,” *Environment: Science and Policy for Sustainable Development* 46, no. 4 (2004): 8–21.

[145] Richard T.T. Forman, “Roadside Redesigns: Woody and Variegated,” *Harvard Design Magazine*, 2006.

[146] Richard T.T. Forman, "Infrastructure and Nature: Reciprocal Effects and Patterns for Our Future," in *Infrastructure Sustainability and Design*, ed. Spiro N. Pollalis (New York, NY: Routledge, 2012), 35–49.

[147] It is also important to not underestimate the importance of Berger's *Drosscape*. As the book focuses on elucidating spatial conditions rather than proposing future interventions, it may have motivated designers to think about these potential futures.

[148] See, for example, Rohatyn, *Bold Endeavors: How Our Government Built America, and Why It Must Rebuild Now*; LePartner, *Too Big to Fail: America's Failing Infrastructure and the Way Forward*; Claire Barratt and Ian Whitelaw, *The Spotter's Guide to Urban Engineering: Infrastructure and Technology in the Modern Landscape* (Richmond Hill, Ont. ; Buffalo, NY: Firefly Books, 2011).

[149] Among countless examples, see Jonathan D. Miller, "Infrastructure: World Overview," *Urban Land* 66, no. 10 (2007): 152–57; "High-Speed Railroading," *The Economist*, July 22, 2010, http://www.economist.com/node/16636101; Will Oremus, "Requiem for a Train," *Slate*, December 7, 2011, http://www.slate.com/articles/technology/technocracy/2011/12/high_speed_rail_is_dead_in_america_should_we_mourn_it_.html; Evan Osnos, "Boss Rail," *The New Yorker*, October 15, 2012, http://www.newyorker.com/magazine/2012/10/22/boss-rail; Ron Nixon, "$11 Billion Later, High-Speed Rail Is Inching Along," *The New York Times*, August 6, 2014, http://www.nytimes.com/2014/08/07/us/delays-persist-for-us-high-speed-rail.html.

[150] Kelly Shannon and Marcel Smets, *The Landscape of Contemporary Infrastructure* (Rotterdam: NAI, 2010).

[151] Kelly Shannon and Marcel Smets, "Towards Integrating Infrastructure and Landscape: In Order to Function, Fit and Be Acceptable, Infrastructure Needs to Enhance the Quality of the Landscape - Three Major Design Approaches Are Overwhelmingly Evident in a Review of Exemplary Built Projects from around the Globe.," *Topos: The International Review of Landscape Architecture and Urban Design*, no. 74 (2011): 64–71.

[152] Ibid., 64.

[153] Jay Hicks, "Leveraging Infrastructure as Open Space," *Urban Land* 67, no. 8 (2008): 99–103.

[154] Ibid., 100.

[155] Christopher Benosky and Shaun O'Rourke, "Ecological Infrastructure," in *Infrastructure Sustainability and Design*, ed. Spiro N. Pollalis (New York, NY: Routledge, 2012), 155–67.

[156] Hauck, Keller, and Kleinekort, *Infrastructural Urbanism*, 83–92; 93–115; 171–185.

[157] Hillary Brown, *Next Generation Infrastructure: Principles for Post-Industrial Public Works* (Washington: Island Press, 2014).

[158] See Brown's list of five key principles of infrastructure on p.11.

[159] Ying-Yu Hung and Gerdo Aquino, eds., *Landscape Infrastructure Case Studies by SWA* (Basel: Birkhäuser, 2013).

[160] Ying-Yu Hung, "Landscape Infrastructure: Systems of Contingency, Flexibility, and Adaptability," in *Landscape Infrastructure Case Studies by SWA*, ed. Ying-Yu Hung and Gerdo Aquino (Basel: Birkhäuser, 2013), 14–19.

[161] Ibid., 15. Hung places this phrase in quotes while discussion Charles Waldheim's role in the establishment of landscape urbanism, though no direct citation is provided. My assumption is that this phrase is Waldheim's.

[162] Ibid., 17.

[163] Ibid., 18.

[164] Katrina. Stoll, Scott. Lloyd, and Stan. Allen, *Infrastructure as Architecture: Designing Composite Networks* (Berlin: Jovis, 2010); Luis Callejas, *Islands and Atolls* (New York: Princeton Architectural Press, 2013); Neeraj Bhatia, InfraNet Lab (Firm), and Lateral Office (Firm), *Coupling Strategies for Infrastructural Opportunism* (New York: Princeton Architectural Press, 2010).

[165] Mostly comparative in nature, studies of this type have received little attention from landscape historians. The on-going merger of environmental history with science and technology studies offers great potential to further these studies. See Sara B. Pritchard, "Joining Environmental History with Science and Technology Studies: Promises, Challenges, and Contributions," ed. Dolly Jorgensen, Finn Arne Jorgensen, and Sara B. Pritchard (Pittsburgh, Pennsylvania: University of Pittsburgh Press, 2013), 1–20; Sara B. Pritchard, *Confluence: The Nature of Technology and the Remaking of the Rhône* (Cambridge, Mass.: Harvard University Press, 2011).

[166] Antoine Picon, "Nature, Infrastructures, and the Urban Condition," in *Ecological Urbanism*, ed. Mohsen Mostafavi and Gareth Doherty (Baden, Switzerland: Lars Muller, 2010), 520–21.

[167] Hauck, Keller, and Kleinekort, *Infrastructural Urbanism*.

[168] Carlotta Daro, "Wired Landscapes: Infrastructures of Telecommunication and Modern Urban Theories," in *Infrastructural Urbanism: Addressing the In-between*, ed. Thomas Hauck, Regine Keller, and Volker. Kleinekort (Berlin: DOM Publishers, 2011), 19–31.

[169] Acker, "Re-tracing the Ringscape—Infrastructure as a Mode of Urban Design."

[170] D'Ambros and Zancan, "Infrastructure's Marginal Spaces and the Invention of a Prosaic Landscape—Visual Knowledge and Design."

[171] Bélanger, "Landscape as Infrastructure." The reversal of these two terms in the title from Strang's 1996 "Infrastructure as Landscape" reveals changing conceptions of infrastructure within landscape architecture.

[172] Bélanger, "Redefining Infrastructure."

[173] Bélanger, "Landscape Infrastructure: Urbanism Beyond Engineering."

[174] For example, compare Bélanger's writing with that of Antoine Picon, who is mentioned earlier in this chapter.

[175] Jennifer Foster, "Off Track, in Nature: Constructing Ecology on Old Rail Lines in Paris and New York," *Nature and Culture* 5, no. 3 (2010): 316–37; Malcolm Woollen, "Les Jardins d'Éole: Extending the Picturesque," *Studies in the History of Gardens & Designed Landscapes* 33, no. 4 (October 1, 2013): 290–304; Ray Gastil, "Prospect Parks: Walking the Promenade Planteé and the High Line," *Studies in the History of Gardens & Designed Landscapes* 33, no. 4 (October 1, 2013): 280–89; Jeremy Foster, "Spectral Denivelations: La Mémoire Du Ail and Topographical Excess at the Jardins d'Éole," *Journal of Landscape Architecture* 7, no. 1 (May 1, 2012): 68–83. Although preceding the timeframe discussed in this section, see also John Dixon Hunt, *The Afterlife of Gardens* (London: Reaktion Books, 2004), 173–190.

[176] Pierluigi Nicolin, "Paesaggi E Infrastrutture = Landscapes and Infrastructures," *Lotus International*, no. 139 (2009): 16–23.

[177] Giacomo Delbene, "Hybridize! Rules of Engagement of Landscape and Infrastructure," in *On Site: Landscape Architecture in Europe*, 2009, 249–51.

[178] Ibid., 249.

[179] Rahul Paul, "From Object Line to Vector Field—The Social Instrument," in *Infrastructural Urbanism: Addressing the In-between*, ed. Thomas Hauck, Regine Keller, and Volker. Kleinekort (Berlin: DOM Publishers, 2011), 49–61.

[180] Frederico Parolotto, "Reversible Infrastructure," *Harvard Design Magazine*, no. 37 (2014): 112–17.

[181] For a thorough examination of the cultural aspects of these marginal spaces, see Matthew Gandy, "Marginalia: Aesthetics, Ecology, and Urban Wastelands," *Annals of the Association of American Geographers* 103, no. 6 (2013): 1301–16. I must also note that this concern for leftover spaces is not new.

For a less specific though more spatially focused study (which is discussed further in the methods chapter, see Roger Trancik, *Finding Lost Space: Theories of Urban Design* (New York: Van Nostrand Reinhold, 1986). Even in 1999 Ken Smith wrote about landscape architecture's recent acceptance of the "margins" rather than cohesive "chunk sites, "Linear Landscapes: Corridors, Conduits, Strips, Edges, and Segues," *Harvard Design Magazine*, Winter/Spring 1999, 77–80.

[182] Rute Sousa Matos, "Urban Landscape: Interstitial Spaces," *Landscape Review* 13, no. 1 (2009): 61–71.

[183] Ibid., 65.

[184] Hauck, Keller, and Kleinekort, *Infrastructural Urbanism*, 117–129, 131–143, 145–157.

[185] Kullmann, "Thin Parks / Thick Edges."

[186] Ibid., 70.

[187] Francesco Repishti also mentions the concept of a reversal of figure and ground when representing linear landscapes, though Repishti is more focused on infrastructure corridors. See "Scavo E Sovrapposizione = Excavation and Superimposition," *Lotus International*, no. 139 (2009): 115–21.

[188] Mattias Qviström, "Network Ruins and Green Structure Development: An Attempt to Trace Relational Spaces of a Railway Ruin," *Landscape Research* 37, no. 3 (June 1, 2012): 257–75.

[189] Ibid., 269.

[190] My research focuses on existing corridors, as abandoned corridors offer completely different situations, problems, and opportunities for landscape architects.

Chapter Three:
Method: Mapping the Landscapes of Infrastructure Corridors

Mapping

Mapping is used here in James Corner's sense of the word—in contrast to the act of tracing, which repeats what is known—as the act of "uncovering realities previously unseen or unimagined, even across seemingly exhausted grounds."[1] What is typically unseen in the research undertaken here is the spatial structure that forms the landscapes of infrastructure corridors. Thus, this method is meant not to re-create what already exists on maps—i.e., the line of conveyance that typically represents a corridor, as seen on a road map—but to reconfigure perception of infrastructure corridors and to further elucidate their spatial structure. The goal of this method is not only to depict but also to provoke. Foregrounding the landscapes of infrastructure corridors is the goal. As Corner notes elsewhere, this change is both "spatial and rhetorical."[2] Corner further argues, that mapping can "inaugurate new grounds upon the hidden traces of a living context" of both natural and anthropomorphic processes.[3] This idea is also appropriate for methods presented here as infrastructure corridors are here examined in response to and in dialog with, when applicable, to both types of processes.

Goals for Method

Developing a method to map the landscapes of infrastructure corridors and their interactions with the surrounding landscape at the regional scale requires striking a balance between scale, accuracy, feasibility, and verifiability. In addressing scale, it is necessary to develop a method that can be applied without difficulty across the extent of a corridor—typically regional, potentially continental. As many infrastructure corridors transcend physiographic and political boundaries, the method has to have the potential to operate independently of those boundaries, if required. This factor demands that any information required for the method is a) easily accessible and independent of the boundaries of any government or private organization; b) scalable, if necessary, to provide the ability to view patterns at various scales; c) function as a reliable indicator even if there are variations in the data used. In addressing accuracy, it is acknowledged that at the regional or continental scale spatial studies do not require the precision of a site scale study—i.e., when looking at the regional scale, patterns and processes of space are more important than identifying the boundaries of a specific site within, say, two feet. Therefore, the method has to develop a reliable and repeatable means of approximately delineating individual sites along a corridor toward the larger goal of illuminating patterns. In addressing feasibility, the method has to be easily deployable and then interpretable by designers without the help of specialized analytic tools, as one of the goals for the research is to provide a method to help designers imagine potential futures for the landscapes of existing infrastructure corridors. In addressing verifiability, the method has to offer a compromise between the detached perspective of remote observation, which enables large-scale studies, and the first-hand observations of an on the ground survey—i.e., some fieldwork has to be included but not across the entire length of an infrastructure corridor.

Precedent Methods

Locating precedent methods that aligned with all of these conditions was difficult, though in surveying various studies a number of insights were gained. An extensive literature exists in landscape architecture on landscape preference studies, scenic landscape studies, and visual analysis.[4] Although methods such as ranking specific landscape features, using coding systems, or using photographic prompting to gather opinions proved to be unrelated to this study, these methods did help to reveal the inherent subjectivity and selectivity of a ground-level perspective. This perspective proved to be necessary to the methods in my research, though was also insufficient by itself. Landscape ecology offered a plethora of examples of ecologists using various types of remote sensing data to study regions.[5] The majority of this literature, unfortunately, relied on the specialized interpretation of various remote sensing data and typically avoided the complexity of the built environment. Studies that did address the urban environment relied on object-based studies that neglected the delineating of landscape sites. One study did suggest the use of photo interpretation methods for manual reading of satellite photos, which proved to be essential to the methods presented here.[6] Another study commented on the value and popularity of manual photographic interpretation, provided the method is undertaken with the appropriate level of ground-level experience.[7] Most importantly, the multi-scale approach of landscape ecology—i.e., placing the specific conditions on a site with a regional pattern or process—offered a potential direction for methods developed here.

Select design studies in landscape architecture—specifically studies undertaken in studio projects and professional firms—offered another potential option with McHargesque plan-based studies of regions. More specifically, academic and professional studios often rely on the mapping of conditions and processes using satellite images as a starting point for analysis or design. By using the interpretation of satellite photos, these studies are largely freed from the restriction of working with geographically limited data, allowing designers to work at larger scales and more complicated conditions. The repeatability, accuracy, and subjectivity of these studies, however, is often unquestioned; there is no reliable set of principles that designers use, other than intuition, to offer repeatable studies. (A few studies do make attempts at creating a working method from this approach, including the use of historic maps.[8]) This subjectivity—perhaps viewed more positively as the prerogative of the designer—does offer the potential for insightful interpretation of complex urban or infrastructural landscapes.[9] When combined with the scale and method of the above-mentioned landscape ecology studies, this approach offers a potential route for the research presented here. Simon Swaffield and M. Elen Deming offer a valuable category of research strategy that is between the poles of subjective and objective: "constructive."[10] The research presented here exists in this middle ground.

Select studies, however, offered more specific advice for methods and research approach. In "Thin Parks / Thick Edges: Towards a Linear Park Typology for (post)Infrastructural Sites," Karl Kullman establishes methods that permit the analysis and classification of sites for linear parks, even though the surveyed sites are more geographically diverse and more urban than those surveyed in the research presented here.[11] Kullman develops a series of figure / ground diagrams, to scale, that allow a number of already built sites to be easily compared. In these diagrams, figure is the space of the park; ground is what surrounds the park or what divides the park, such as roads or buildings. From these diagrams, Kullman is able to then generate an extensive list of the characteristics of thin parks, which are then further refined to a series of typologies, also expressed diagrammatically. The typology moves beyond objective spaces and attempts to convey, at times, the experience of the sites. The purpose of the typologies is to "provide a baseline which is of descriptive and prescriptive use to landscape architects attempting to both read existing thin parks and conceive new park designs for thin sites."[12] Kullman's easily interpretable diagrams are highly effective in conveying the various sites and spatial relationships he discusses.

In "Network Ruins and Green Structure Development: An Attempt to Trace Relational Spaces of a Railway Ruin," Mattias Qviström seeks to establish the spaces (and quality of spaces) along a 35 km stretch of a former railway. Qviström's method involves the use of historic maps, photographs, and documents to discover sites related to the main corridor, such as mines and processing facilities. From these documents, Qviström then establishes a plan-based diagrammatic map to depict the relationships of the various sites. Although the availability of these documents is too unpredictable and dependent upon local conditions to be applicable to the research method discussed in this thesis, Qviström's use of the diagrammatic plan to reveal a relatively large-scale condition does provide an appropriate path forward, building on Kullman's methods to bolster the argument for clear, concise, and legible diagrams to express typically unseen spatial conditions.

Less focused on method, though providing a research process that is directly applicable to the methods proposed here, "Vacant Land: A Resource for Reshaping Urban Neighborhoods," part of Anne Whiston Spirn's West Philadelphia Landscape Plan project, takes a relatively unseen spatial condition in a specific context and creates a classification that then allows designers to more easily address that spatial condition.[13] The study first describes the characteristics of vacant land in West Philadelphia at the city scale and then the block scale. From these characteristics, a series of vacant land types are developed and illustrated using sections and plans. This typology becomes an easily communicated and understood platform upon which a designer can then propose alternate programs for these sites. Classification provides designers with an approachable, interpretable problem from an otherwise chaotic spatial condition.

Richard T.T. Forman in *Urban Regions: Ecology and Planning Beyond the City* expressed concerns toward automation, similar to those identified above in the landscape ecology discussion, during method research for his study.[14] Forman conducted the study, which ambitiously attempts to describe and depict the ecologies of a wide selection of global cities, through drawing sketches of identifiable patterns, processes, and objects on transparencies placed on top of printed satellite photographs. With the help of an illustrator, these sketches were made into vector diagrams of each city's ecology, using various symbols and colors to represent different ecosystems and infrastructures. Before describing and ultimately using this method, Forman expresses frustration at the lack of a more scientific approach, though he does mention that this method allows him to incorporate his personal experience and to blend subjective and objective observations to provide a more cohesive series of diagrams. In Forman's view, the complexity of the urban environment, especially when addressing a condition other than a built structure, demands manual interpretation.

That no specific methods provided an ideal model for the research presented here speaks to Swaffield and Deming's argument that landscape architecture research problems often "emerge from a wordly context rather than from the existing knowledge of the discipline."[15] Swaffield and Deming, therefore, argue for a hybrid approach to research strategy and method in landscape architecture. This approach is taken in the research that follows, building on Swaffield and Deming's research strategy of classification and then eventually shifting toward design projection.[16]

Mapping Method

Moving forward from the above studies, the following method was developed (through a process described in the next section). What follows below presents the specifics of this method as applied to the case studies that are included in this thesis. It is important to note, however, that this method was developed to support two outcomes: 1) to develop a method that can assess the potential for a new spatial concept of infrastructure corridors; 2) to develop a method that can be applied by other designers to allow them to also confront spatial issues of infrastructure corridor at the regional scale.

First, infrastructure corridors were selected to study. Two approaches could have been taken: a selection of different corridors within the same region; a selection of the same type of corridor though in different regions. Both approaches have merits. For my study, the first option was chosen as part of my research was to define a method for studying the spatial structure of infrastructure corridors, which required 1) the ability to access the corridors on a regular basis to test proposed remote sensing methods; 2) the opportunity to test the methods on various types of corridors. Three corridors—Interstate 80, the Norfolk Southern Railway Eastern Division, and a portion of the Susquehanna-

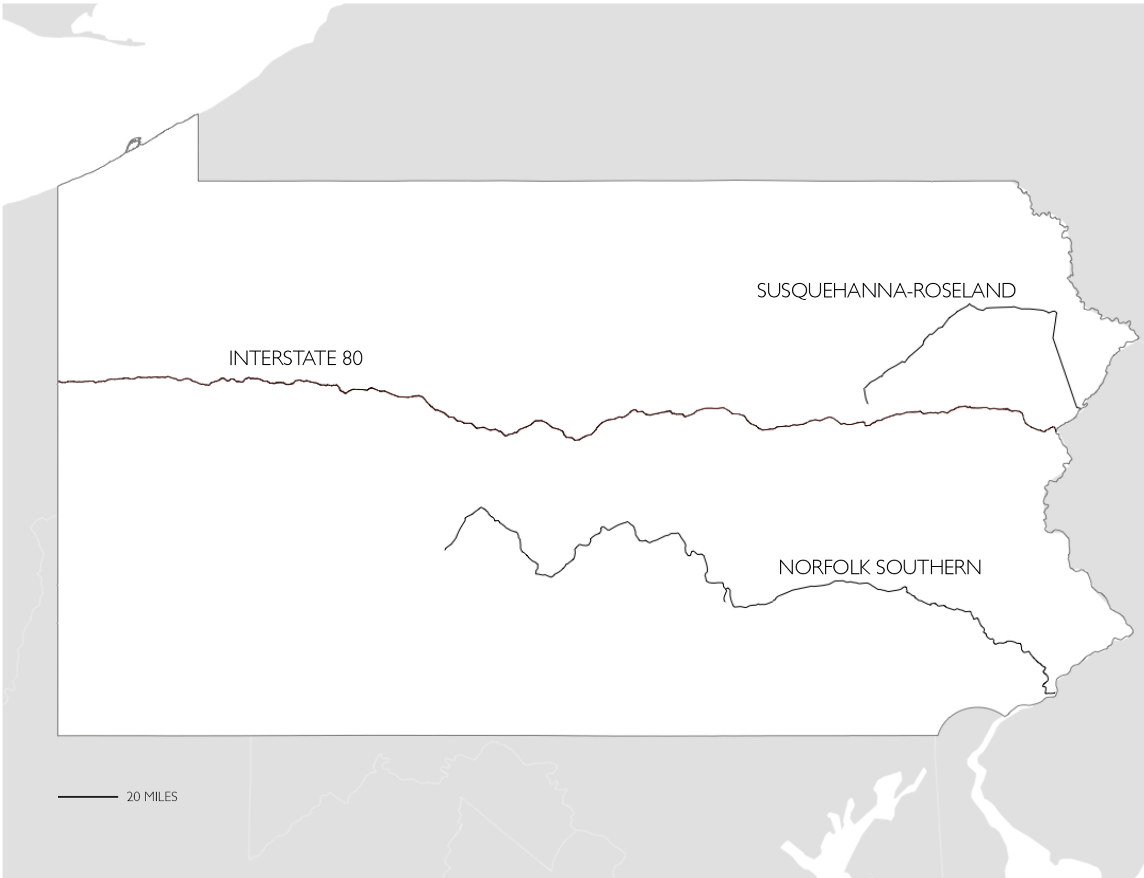


Figure 1 Corridors Selected for Study.

Roseland 500-kilovolt electric transmission line—were selected in Pennsylvania. The locations of selected corridors are indicated in Figure 1. Beyond that the corridors were accessible, Pennsylvania is situated both as a focal point of infrastructure corridors in its "keystone" position between the coast and the interior, and because Pennsylvania is a topographically and geologically diverse state with primary infrastructure corridors running against the grain of these structures. This creates a wider variety of situations that reveal how infrastructure interacts with the surrounding landscape than would a flat state with a homogenous geology.

Figure 2 Interstate 80 on the Allegheny Front. Note how the median widens significantly in response to the topography.

After selecting these corridors, a base layer of satellite photographs was created in GIS software. In this study, Cartographica by Clue Trust was used to establish a continuous base map of full color satellite imagery licensed via Cartographica from Bing Maps. After shape files for the line of conveyance in each corridor were developed, a brief computer-based survey was used to gather a basic understanding of each corridor. The goal of this survey was to preliminarily develop what types of variety were present within the spatial structure of the landscape of each corridor. Where, for example, did the corridor widen? Where were unusual conditions observed? How did the corridor interact with towns? (See Figure 2.) Further, objects or patterns that appeared to form a boundary for sites within or along the corridor were noted. (See Figure 3.) The ultimate goal of this phase was to identify zones of the

Figure 3 Boundary of Rail Yard near Altoona, Pennsylvania.

corridor that should be visited and explored on the ground.

Areas selected to visit were typically identified as major changes of physiographic features—such as Interstate 80 climbing the Allegheny Front or Susquehanna-Roseland crossing a mountain—but were also related to extractive industries or the built environment—such as the Norfolk Southern's former Altoona Railroad or Interstate 80 interacting with areas of strip mining on the Appalachian Plateau. At this phase it was important to note the wider trends that had to be identified and observed on the ground. From this point, a language of each corridor was being developed—a language that enabled the corridor itself to be read like a geographic text. In developing this language and in reading the corridor, the Bing Maps base layer permitted shifting between various scales, allowing specific sites to be situated in larger patterns. Cartographica proved to be immensely helpful as it provided a seamless and rapid means of shifting between scales. This shifting can occur because the grid of satellite images that Bing Maps uses is contained in different levels of spatial resolution depending on the geographic area encompassed by the specific view.

Figure 4 Susquehanna-Roseland Corridor.

From these initial attempts at reading the corridor, a series of corridor visits were planned. Toward supporting the goal of having these methods be approachable and efficient for a design process, economy of these visits was desired. Trips were planned in order to further develop the language of each corridor, as mentioned above. It was realized, after a number of trial field visits, that the most efficient path to developing this language was to visit the physiographic region that an infrastructure corridor crosses, as it seems that the language to read a corridor remotely is primarily determined by topography and vegetation. In areas of intense development, either agricultural or urban, reading the boundaries of infrastructure corridors is less difficult as there are more markings on the land to read—e.g., field boundaries, roads, fences. With its topographic variability, Pennsylvania provided a challenging yet ideal location to test this approach.

Visits were focused on developing a better understanding of the corridor and its spatial structure, noting areas of unusual width or shape within the corridor or alongside the corridor. The focus was on pattern. Each type of corridor required a different approach to observation. Interstate 80 proved to be the most accessible, since a public highway is housed within the corridor. The Norfolk Southern was accessible because many towns and cities along its route contain rail yards (or abandoned rail yards) that are adjacent to or crossed by public roads. However, this corridor did prove to be difficult to follow through private land. Fortunately, where the corridor could be seen at road crossings permitted enough of an understanding of the corridor that could then be extrapolated using satellite images later in the process. The Susquehanna-Roseland electric transmission line was particularly difficult to survey on the ground due to its tendency to avoid populated areas and roads. Given the relatively simple configuration, alignment, and cross-section of the corridor it was possible to take this limited information and extrapolate via satellite images. The idea of extrapolation is key to

Figure 5 Interstate 80, Allegheny Front, Looking Southeast.

efficiency in surveying infrastructure corridors. Because the corridors are largely an engineered response to the existing terrain, there is much repetition in the boundaries and sites of corridors. When this pattern is discovered and understood, remote surveys become more reliable. This idea extends into the wider landscape—e.g., when the economy of the landscape surrounding a corridor is known, it becomes easier to identify the location, extent, and current use of potential adjacent sites.

After field visits to the corridors, the concept of a site was determined to be an appropriate solution in delineating the spatial structure of each infrastructure corridor.[17] A site was defined as a contiguous area without any significant topographic or land-use changes; because no specific intervention was proposed at this point, a change in the shape of a site did not signify a new site—i.e., if there was a square parcel adjacent to a linear parcel, both were grouped into the same site. Sites along each corridor were mapped using Cartographica to create georeferenced polygons. Beyond sites located within the corridor, select sites adjacent to the corridor were also mapped. These selections were limited to lands that had the potential to be available to be leveraged into a landscape intervention within the next 25 years—e.g., abandoned truck stops, areas of geologic extraction, fallow fields, unused parking lots, outdated industrial facilities. Most of these, though not all, indicate how the initial development of the corridor influenced the surrounding landscape. Existing vegetation, though noted, did not influence site selection. This choice was made based on the probability that the timeline of any proposed intervention extends beyond the life of individual plants or communities—i.e., a forest may seem permanent in the present moment but over a span of 50 years its existence may be more ephemeral. Both types of sites were outlined using a 50% transparency color, selected as appropriate for the color conditions of the satellite photographs that are being used. Typically a highly saturate red was used for corridor sites and neon green for adjacent sites. The result of outlining the sites was a shape file, which could be imported into any GIS software or Google Earth. As is standard in any GIS software, each created polygon was automatically assigned a number, allowing for accurate future reference, if necessary.

To accurately and reliably delineate sites the principles of aerial photography interpretation, sometimes known more generally as image interpretation, were vital. These principles have been in use, and have continued to be refined, since the earliest days of aerial photography. Many of the more reliable techniques were developed through spying on complex urban and industrial landscapes during World War II.[18] John

R. Jensen in *Remote Sensing of the Environment, An Earth Resource Perspective*, diagrams these principles in a pyramid.[19] (See Figure 6.) At the top of the pyramid are the most basic principles for identifying objects and spaces in aerial photographs: location and tone/color. Location is awareness of the 'xy' coordinates. These coordinates allow for the identification of already known sites and objects. Tone / color, marking the distinction between color and black and white photographs, is the value of a surface or object in the real world as represented by an individual pixel or grain of photographic paper. In describing the value of tone / color to image interpretation, Jensen uses the examples of differentiating between spruce and deciduous forest stands during the summer.

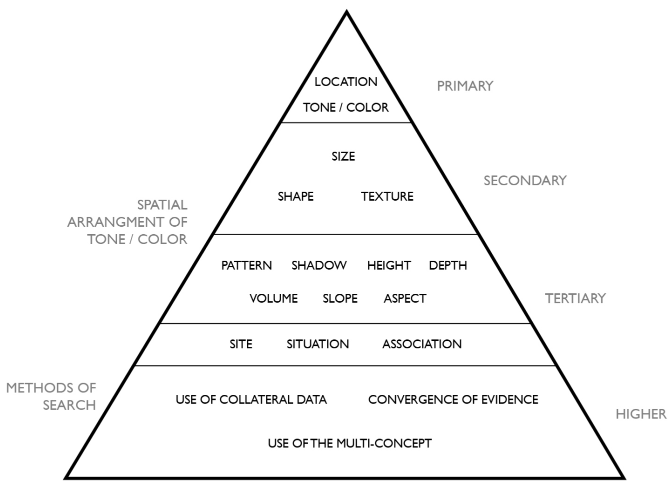


Figure 6 Elements of Image Interpretation, Order and Methods of Search. Adapted from Jensen, *Remote Sensing of the Environment,* 132.

Moving further down the pyramid, secondary and tertiary principles are derived from the spatial arrangement of tone / color. Size can be any combination of length, width, perimeter, and area, and is typically related to generating an awareness of scale for the area being analyzed. Elements that do not change size over large geographic areas—e.g., highway lane width, the space between railroad tracks—provide a helpful example of scale for recognizing other objects. Shape is important in distinguishing between various objects and areas, though repetition of the same shape in different situations can create identification problems. Texture is particularly helpful in drawing a distinction between different types and ages of vegetation. Moving to tertiary principles, the complexity increases again. Previous principles layer to allow for more complex analysis and identification. Pattern addresses the arrangement of objects or shapes, typically created through some anthropomorphic or natural process. Shadows help to identify tall or complex objects that are not recognizable only from above. However, shadows can also obfuscate otherwise simple identifications. Height, depth, volume, slope, and aspect can often be discerned even from monoscopic images, though may not be reliable unless verified in the field.

Beyond these three levels of basic principles, image interpretation becomes increasingly contextual and synthesizing. Jensen proposes sites as a collection of physical or socioeconomic characteristics and he places sites within a large pattern, even if that pattern is regional. Sites are contextualized through identification and understanding of the larger patterns that influence them. Situation addresses how various types of objects are arranged in a given area. Jensen mentions examples such as the arrangement of buildings or how various raw materials are placed near a factory. Building on situation, association is how one activity occurring at one site is related to an adjacent site. Identification of both sites often relies on the relationship between the two sites. Jensen notes that this level of analysis often requires experience on the ground in the area where analysis is being conducted. This level of analysis veers toward narrative: an individual interpreting an aerial or satellite photograph needs to reconstruct the narrative of a specific site and place that site within the narrative of the region. To further contextualize image analysis, Jensen introduces a “higher” category of analysis that contains three strategies to identify and delineate objects and sites in photographs. Using collateral information involves incorporating outside data into any analysis. Even a road grid, Jensen argues, can be helpful when manually interpreting photographs using GIS software. Convergence of evidence relies on the concept of working from what is known to what is not know. In this process, the shift from known to unknown often eliminates factors that are preventing a correct identification. The multi-concept, developed by Robert Colwell in the 1960s, proposes the use of multispectral, multidisciplinary, multiscale, and multitemporal photographs to create the most reliable analysis. Most relevant to the method pursued in the research presented in this thesis is multiscale. Because of the perspective that working in different scales provides, Colwell argued that using imagery that ranged from small scale to larger—with the largest being field studies—was the key to best situation sites and identify objects.

These principles assisted in the development of specific approaches to each of the three corridors addressed in this study. In all of the corridors, because of their location in a temperate region, vegetation was an important indicator. Changes in vegetation age or vegetation type reliably predicted the boundaries of sites—e.g., mowed grass to meadow, birch forest on an abandoned industrial site to the oak forest of a neighboring parcel. Often these changes of vegetation relied on more than color or tone change interpretation. In many cases the situation and context of the corridor and the site had to be considered. Viewing each corridor and each site within a context of the surrounding landscape’s history was helpful in these situations. Specifics of history were not necessary but a general sense of the formation of the corridor and the use of the surrounding land was essential. Each corridor also offered the chance to apply image interpretation principles in different manners, principally in defining the boundaries of the sites that compose the corridor. Because Interstate 80 is a controlled access corridor that is enclosed with a chain link fence, discovering the boundaries of the corridor and sites often required locating the fence. In short vegetation—grass, meadow, or farm field—this was often accomplished through visually locating the fence or in locating the taller vegetation and trees that have colonized the unmaintained fence zone. In a forested area, the fence was located, if possible, though a change in the age of the surrounding forest. If no obvious signs for the fence could be located, the surrounding context—i.e., adjacent areas where the fence could be located, provided a reasonable means of identifying boundaries without seeing the fence. Delineating sites along the Norfolk Southern Railway, which is not surrounded by a fence, relied more heavily on changes in vegetation age and composition. Context was also helpful, since by reading the grain of the surrounding landscape through vegetation change it was often possible to detect the boundaries of the corridor and of adjacent sites. Industrial sites and abandoned rail yards that flowed with grain of the mainline often required this type of identification,

Figure 7 Vegetation Change Indicating Unused Rest Area Site.

but were reliably identified through context. The Susquehanna-Roseland electric transmission line proved to be the simplest corridor to delineate boundaries due to the fact that the corridor primarily runs through a forested area that is cleared to the limits of the corridor. In these areas, the owner of the corridor maintains complete control of the vegetation on the ground plane. However, in places the line crosses zones of agricultural and residential development where the owner of the corridor only controls the placement of tall trees within the corridor. Therefore, it was necessary on this corridor to distinguish between areas of the ground plane that were under the control of the corridor owner and those that were not.

With this mapping complete, sites for each corridor were exported to a vector file format. Sites along the corridors were shaded black; sites adjacent to the corridors were shaded 50% gray; land surrounding the corridor and the corridor itself were shaded white, creating a figure / ground drawing with the landscape of each corridor as the figure and with the corridor and the surrounding landscape as the ground. Scaled appropriately, sites were then placed into two types of catalogs: a linear catalog that depicted the sites as they are exist in the physical world, with relevant details; a gridded catalog that disassembled the corridors and then depicted the sites on a 7 x 9

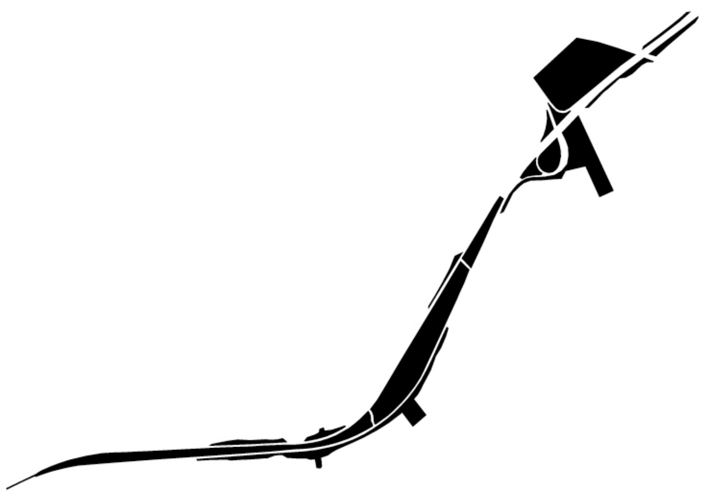


Figure 8 Sample of Figure / Ground Drawing Interstate 80.

grid, running from east to west along the corridor. Smaller sites were placed directly on the grid, while larger sites covered multiple points on the grid. This approach provided spatial information on the landscape of each corridor in three valuable formats: 1) in a shape file within Cartographica's interface that permits using multi-scale satellite photographs to be analyzed if further details are required; 2) in a series of 8.5" x 11" segments of the complete corridor, providing a figure / ground version of the corridor for analyzing trends and patterns in the corridor; 3) in a series of 8.5" x 11" segments of disassembled landscapes of corridors placed on grids to facilitate shape, scale, and pattern comparative analysis. (See Appendices A-F.)

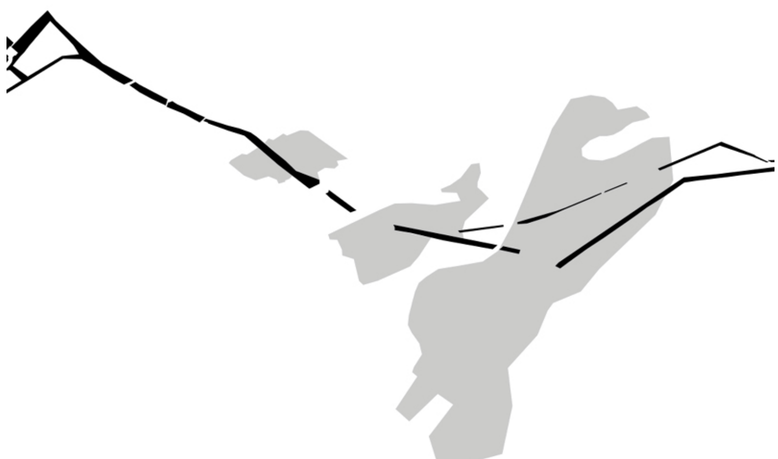


Figure 9 Sample of Figure / Ground Drawing for Susquehanna-Roseland.

When this method is applied to other corridors, these three formats are the base data that could allow any landscape designer to begin to study the spatial structure of specific infrastructure corridors. The diagrams offer spatial specificity with a diagrammatic simplicity that facilitates comparative study. The landscape of the corridor is revealed. This method, then, results in data that can be used for both representation and comparative analysis. However, as it impossible to predict the factors or situations that could influence the study of other infrastructure corridors, it is important to note that this diagrammatic phase is only a starting point for further study; in many cases it might be necessary to further contextualize these diagrams through field surveys or historical research.

In the three case studies present here, this base data was then used to inform a series of studies to begin to better understand the potential of developing a new concept of infrastructure corridors. Therefore, the goal of the research was not necessarily the creation of specific proposed interventions but rather the proposal of a theoretical view of infrastructure against the spatial structure of existing infrastructure corridors. Toward this goal, the base data were used to categorize the sites that exist along each corridor, to study how residents and users of the corridors interact with and experience these sites, and how these sites might be leveraged into systems using the existing method of conveyance (or potential conveyance) within the corridor. The base data was essential to these studies, though additional field visits and research were required to study many of these factors. The concept of "situated knowledge," defined as information learned while actively engaged in the movement through and study of a landscape, was an important component of these case studies.[20] In this thesis, specific categorizations and insights from these case studies are placed in chapters that being with the prefix "situation."

Mapping Trials

Toward concluding this chapter and toward instigating future research, it is necessary to mention that the method ultimately used was developed through a series of trials that involved various base layers and field visits to assorted sites. What follows is an attempt to outline the most relevant mistakes and observations from this process.

During these trials—specifically by attempting to outline sites along Interstate 80 in a GIS program—it became apparent that satellite photographs by themselves would be insufficiently accurate, even using principles of photographic interpretation. Site visits, while initially proving this inaccuracy, also allowed a degree of on the ground verification that improved the quality of satellite photograph interpretation. After four of these trials—visiting select sites on each corridor—it became clear that what was required for the best accuracy was a visit to the specific physiographic region that a corridor crossed—e.g., Ridge and Valley, Appalachian Plateau. This is based on the idea that the sites that compose infrastructure corridors, even if unintentional, change in response to local geomorphology and land use. By visiting the area, even briefly, it became possible to understand the infrastructure corridor from satellite photographs. This is the language of the corridor that is described above. Knowing this language is key to reliable satellite image interpretation, a point supported by instructive literature on image interpretation. Although not pursued here, a valuable study could be undertaken to determine the minimum extent of field surveys with these methods while still maintaining an acceptable level of accuracy. Is it possible, for example, to accurately analyze satellite photographs after visiting only 10 miles of a corridor? Or to use only the interactive photographs available on Google Street View?

In one initial trial, digital elevation models and then contours were used as a base layer in an attempt to delineate sites along Interstate 80 through topography. Though at first glance the results appeared promising, after a site visit it was realized that the manipulated terrain that was revealed through the DEM was significantly underestimating the size of sites along Interstate 80. The Norfolk Southern could, in places, be more accurately located by topographic information because of the use of ballast to support tracks during line construction. However, at the fringes of the corridor and in adjacent sites, topography became less reliable. Construction of the Susquehanna-Roseland electric transmission line was less reliant upon manipulation the ground; topography was not helpful toward defining its sites. It was also thought that a DEM might provide valuable detail for site typologies, even if not for the delineation of sites. However, the topography of an infrastructure corridor, as an engineered object, tends to have a predictable response to existing topography, allowing topography to be dealt with typologically rather than on a site by site basic. Further, smaller-scale studies of the future of these sites would obviously require more specific topographic detail. This information can be easily found, using the shape files created in the method presented above, when necessary. For this study, however, it is argued that topographic information for each site obfuscated larger patterns.

Initial trial studies were undertaken using a single tone to delineate sites within corridors—i.e., a median site along Interstate 80 was filled with red in GIS software and then black once exported to the vector file format. The simplicity of a black and white diagram was desired to easily communicate the pattern of these sites, following the lessons learned from precedent method studies. However, after running trials it was discovered that a single category of sites along each corridor failed to allow for any potential sites that are adjacent but not included within the infrastructure corridor. The problem is that this approach would have removed any connection between the corridor and surrounding cultural and natural processes. With this realization, a second color was added to depict adjacent sites.

On a concluding note, even after the outlining of sites along a selection of corridors in Cartographica, the representation of the sites is a potential area of research. While the presentation here is limited to 8.5” x 11” sheets as demanded by the prescribed thesis format, larger formats could present more evocative and revealing types of representation. The format of an exhibit or of a sequential display using digital technology holds much promise. Further, presenting connections between various scales appears to be a strong method to convey the scale of the sites within the landscapes of infrastructure corridors. For example, if presenting a series of posters that depict the sites of a single corridor it would be powerful to take the smallest site on the poster and somehow reveal it at a 1:1 scale in the vicinity of the poster, either through a label adhered to the floor or through the placement of corner marking objects somewhere in a building, parking lot, or adjacent landscape.

[1] James Corner, “The Agency of Mapping: Speculation, Critique, and Invention,” in *The Landscape Imagination: Collected Essays of James Corner, 1990-2010*, ed. James Corner and Alison Bick Hirsch (New York: Princeton Architectural Press, 2014), 197.

[2] James Corner, “Aerial Representation: Irony and Contradiction in An Age of Precision,” in *The Landscape Imagination: Collected Essays of James Corner, 1990-2010*, ed. James Corner and Alison Bick Hirsch (New York: Princeton Architectural Press, 2014), 136.

[3] Corner, “The Agency of Mapping: Speculation, Critique, and Invention,” 198.

[4] For commonly cited examples, see Thomas Priestley, “The Field of Visual Analysis and Resource Management: A Bibliographic Analysis and Perspective,” *Landscape Journal* 2, no. 1 (1983): 52–59; Jay Appleton, “Landscape Evaluation: The Theoretical Vacuum,” *Transactions of the Institute of British Geographers*, 1975, 120–23; Ervin H. Zube, James L. Sell, and Jonathan G. Taylor, “Landscape Perception: Research, Application and Theory,” *Landscape Planning* 9, no. 1 (1982): 1–33; A. T. Williams and C. D. Lavalle, “Coastal Landscape Evaluation and Photograph,” *Journal of Coastal Research* 6, no. 4 (October 1, 1990): 1011–20.

[5] See, as a frequently cited example, Michael A. Lefsky et al., “Lidar Remote Sensing for Ecosystem Studies,” *Bioscience* 52, no. 1 (January 2002): 19–30.

[6] Martin Herold, XiaoHang Liu, and Keith C. Clarke, “Spatial Metrics and Image Texture for Mapping Urban Land Use,” *Photogrammetric Engineering & Remote Sensing* 69, no. 9 (2003): 991–1001.

[7] Jessica L. Morgan, Sarah E. Gergel, and Nicholas C. Coops, “Aerial Photography: A Rapidly Evolving Tool for Ecological Management,” *BioScience* 60, no. 1 (2010): 47–59.

[8] Wybe Kuitert, “Urban Landscape Systems Understood by Geo-History Map Overlay,” *Journal of Landscape Architecture* 8, no. 1 (May 1, 2013): 54–63.

[9] See the critique of positivism in James Corner, “Three Tyrannies of Contemporary Theory,” in *The Landscape Imagination: Collected Essays of James Corner, 1990-2010*, ed. Alison Bick Hirsch and James Corner (New York: Princeton Architectural Press, 2014), 77.

[10] Simon Swaffield and M. Elen Deming, “Research Strategies in Landscape Architecture: Mapping the Terrain,” *JoLA - Journal of Landscape Architecture* 2011, no. 11 (April 2011): 34–45.

[11] Kullmann, “Thin Parks / Thick Edges.”

[12] Ibid., 78.

[13] Anne Whiston Spirn, *Vacant Land: A Resource for Reshaping Urban Neighborhoods* (West Philadelphia Landscape Plan (Department of Landscape Architecture and Regional Planning, University of Pennsylvania), 1990).

[14] Forman, *Land Mosaics*.

[15] Swaffield and Deming, “Research Strategies in Landscape Architecture: Mapping the Terrain,” 43.

[16] Ibid., 37.

[17] Although the literature on sites is broad—and a complete or even partial review of the literature is beyond the scope of this work—see Steen A.B. Hoyer’s discussion of the “specificity of site” in “Things Take Time and Time Takes Things: The Danish Landscape,” in *Recovering Landscape: Essays in Contemporary Landscape Theory*, by James Corner (New York: Princeton Architectural Press, 1999), 72. See also David Leatherbarrow, *The Roots of Architectural Invention: Site, Enclosure, Materials* (Cambridge [England]; New York, NY, USA: Cambridge University Press, 1993); Lyster, “Landscapes of Exchange: Re-Articulating Site”; Julia Czerniak, “Looking Back at Landscape Urbanism: Speculations on Site,” in *The Landscape Urbanism Reader*, ed. Charles Waldheim (New York: Princeton Architectural Press, 2006), 105–24; Kullmann, “Thin Parks / Thick Edges.” (Further, the literature of sites is largely implied, in that the idea of a site so saturates the academic and professional field of landscape architecture that the concept is frequently used, both in literature and studios, without question or clarification.)

[18] American Society for Photogrammetry and Remote Sensing. and Warren R. Philipson, *Manual of Photographic Interpretation* (Bethesda, Md.: American Society of Photogrammetry and Remote Sensing, 1997).

[19] John R Jensen, *Remote Sensing of the Environment: An Earth Resource Perspective* (Upper Saddle River, NJ: Pearson Prentice Hall, 2007).

[20] Raymond B Craib, *Cartographic Mexico: A History of State Fixations and Fugitive Landscapes* (Durham, N.C.: Duke University Press, 2004), 157.

Chapter Four:

Situation: Site and Corridor Characteristics

Situation Introduction

In order to study the landscapes of infrastructure corridors, to apply the method described in the previous chapter, and to collect observations that can inform a new concept of the landscapes of infrastructure corridors, this chapter is the first of three that examines the spatial structure of the specific case studies in my research. The purpose is to shift the discussion of infrastructure toward specific situations that inform theory. What follows in the following three chapters is largely descriptive, drawn from both the diagrams developed through the method above and from ancillary research.

In this chapter, locations of sites are described and a typology of sites is generated for each corridor. (In the following two chapters, further attributes of these corridors will be discussed.) The purpose of the approach in this chapter is two-fold: 1) to separate the sites of these corridors from their spatial arrangement, toward the goal of better understanding what types of sites exist along the corridor; 2) to begin a process of categorization, which is helpful toward developing a new conception of infrastructure corridors and has the potential to be helpful for future designers who consider the design of the landscapes of infrastructure corridors, either with these specific corridors or as a design analysis approach for other corridors.

As mentioned in the previous chapter, complete linear and gridded catalogs for each corridor were generated. These catalogs have been placed in appendices A—F, as indicated in each heading below. The discussion below draws from and expands upon fragments of these catalogs.

Figure 10 Interstate 80 near Milesburg, Pennsylvania. (Source: BING Maps)

Site and Corridor Characteristics: Interstate 80
(For catalogs, see Appendices A and D.)

Although Interstate 80 connects the New York City metropolitan region to San Francisco, California, the portion mapped in my research is only the 310 miles within the state of Pennsylvania. This portion was built on a new alignment—i.e., not in place of an existing highway—between 1960 and 1970. Because of the relatively late date of construction, some secondary roads cross the highway, either on overpasses or through underpasses. The road surface is primarily concrete with two lanes for traffic in each direction. To a driver's right, there tends to be a lane-width concrete verge, while to a driver's left—i.e., left of the left lane— there tends to be a narrow concrete verge. Although this pattern varies, this is the most common arrangement of lanes.

Moving from west to east, from the Ohio border, the interstate gradually ascends the undulating but ever rising dissected topography of the Appalachian Plateau before descending the Allegheny Front to enter Ridge and Valley. Further east, the interstate climbs the Pocono Plateau before entering into New Jersey through the Delaware Water Gap. These physiographic regions affect the design and placement of the highway. On the Appalachian Plateau, the highway crosses many ravines and through intermittent areas of farming, coal mining, and forest. In Ridge and Valley, the highway cuts through farm fields and woodlots in the valleys and forests when sited on a ridge. Because of the linear nature of Ridge and Valley ridges, the highway often parallels a valley for an extended distance before crossing a ridge via a water gap to the next valley. West of the Allegheny Front, the highway frequently crosses through areas of land that were strip mined for bituminous coal and then abandoned. For the majority of its length in the state, Interstate 80 crosses through rural areas. The alignment of the highway, due to its mid-twentieth century construction, tends to avoid populated areas. However, east of the Pocono Plateau, twentieth century commercial and residential development exists alongside the highway.

Along the portion in Pennsylvania, 1,280 sites within the landscape of the corridor were mapped. In general, these sites present extremely linear characteristics, as the boundaries of the right of way tend to be efficiently sited in relation to the road surface itself. Even with this linear character, however, these sites tend to be larger than perceived while driving along the highway at seventy miles per hour.[1] There is also a striking amount of variety within the sites, as the linear corridor of the highway responds in many ways to topography and surrounding land use. These sites are discussed below in general categories that illuminate trends and patterns while also noting this diversity.

Right of Way Sites

The most ubiquitous and obvious sites that exist within the landscape of the Interstate 80 corridor are the typically linear sites within the right of way to the outside of the road surface—i.e., to a driver's right traveling in either direction. These sites frequently, but intermittently, contain road signs, bridge abutments for secondary roads, and emergency pull-offs. Access to the sites is not available from the highway corridor, though the potential exists to create additional pull offs (not exits) to access the sites for official use. While traveling on Interstate 80 these sites appear as a continuous and unchanging buffer between the highway and surrounding parcels of land. However, the spatial reality is that these sites change frequently in response to surrounding land use and topography. Although no precise regulations exist, the highway is typically engineered to contain a 60 to 80 foot buffer between the edge of the concrete and the boundary of the right of way. Of this, 40 feet is by regulation required to be free of any obstruction greater than 4 inches in diameter that is not designed to snap if a vehicle contacts the object. The precision of the application of this regulation appears to vary greatly, and often the 40-foot restriction is avoided entirely through the installation of guiderails.

These right of way sites exist in a variety of configurations. The width of the buffer varies significantly depending on the surrounding land use. In urban or suburban areas, presumably areas with higher land prices at the time of construction, the right of

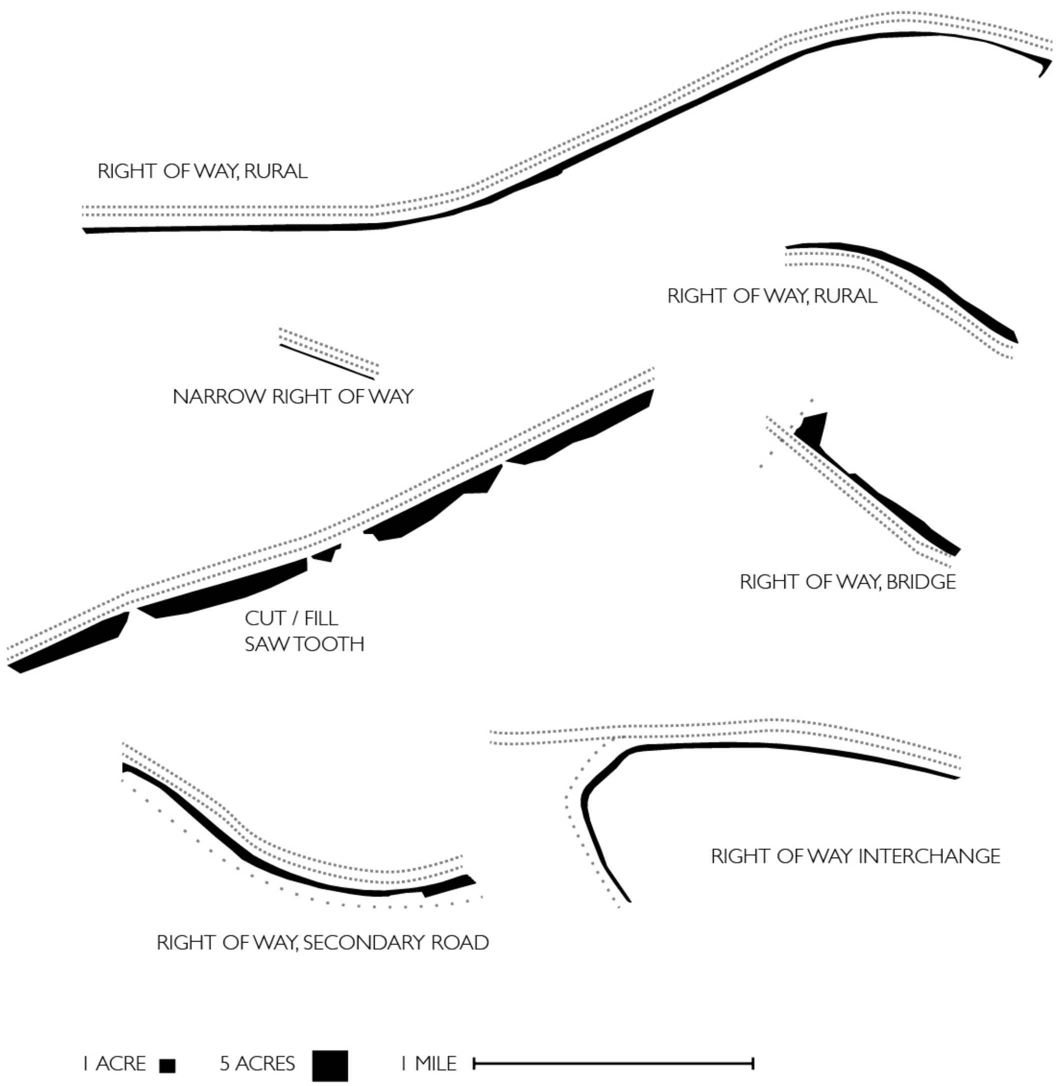


Figure 11 Right of Way Site Categories, I-80. Dotted lines indicate position of traffic on highway; less dense dots indicate traffic on a secondary or merging road.

way sites are minimal, often only 40 feet wide and frequently divided by secondary roads and exits. However, in rural areas—with presumably lower land prices at the time of construction—right of way sites will often exceed 120 feet and are uninterrupted, in places, for over a mile, bending with the curvature of the highway. In rural areas, these sites also interact with surrounding land use, especially in agricultural areas. For example, if during the land acquisition process 95% of a farmer's field was purchased by the Pennsylvania Department of Transportation, the remainder of the field was occasionally lumped into the right of way, even though it wasn't necessary for engineering requirements, giving the site an uneven edge facing away from the corridor. This condition also exists where a rest stop or construction staging area is situated within an otherwise linear site. Right of way sites also tend to increase in width where a secondary road crosses the highway via a bridge, creating a site that forms an enlarging wedge from the typically narrow buffer. These sites can often be 80 feet wide. In a more extreme example, in areas of convoluted topography, where massive cuts and fills were required during highway construction, the right of way often assumes a saw tooth character, extending dramatically—up to 250 feet in width—in areas of cutting or filling. Where a secondary road parallels the limited access highway, there is frequently an exaggerated buffer of between 160 – 320 feet. At interchanges, a typically linear right of way site is often distorted by the presence of the other road at the interchange, wrapping around a cloverleaf intersection to form a complex yet continuous site. When this type of interchange occurs in areas that required cutting and filling during construction, the width of these sites also varies considerably.

The sectional profile of these sites varies depending on the conditions. At times, the linear sites exist on the same ground plane as the highway and are level, as when the highway passes through an agricultural field. More typically, the sites slope either away or toward the highway, in relation to the necessary cutting and filling; in places the area of the site furthest away from the highway has a level shelf. Where more extreme cutting into rock was required, right of way sites exist between 20 and 200 vertical feet above the roadway.

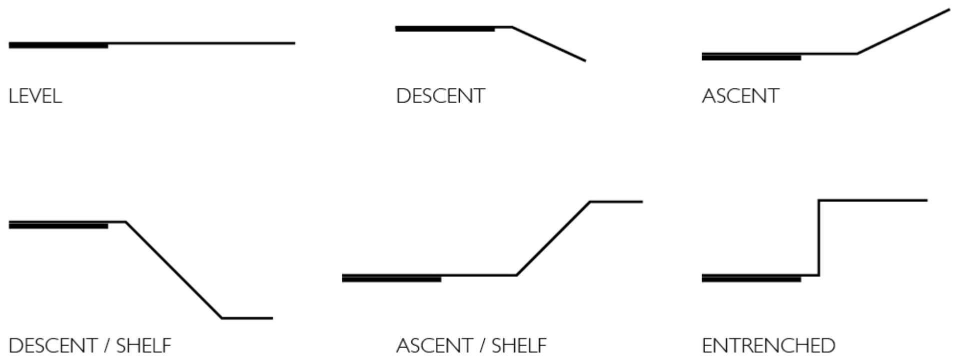


Figure 12 Sectional Variation of I-80 Right of Way Sites. Thick line indicates travel lanes.

Median Sites

If linear sites are the most obvious while driving along Interstate 80, median sites are perhaps the least obvious, and are here defined as any site that exists between the two primary lanes of travel. The genesis of these sites is the frequent engineered separation of eastbound and westbound travel lanes. When these lanes separate, a site of varying width and length is created between the lanes. Median sites are most recognizable from an aerial perspective. These sites often contain pillars for secondary road bridges, access lanes for emergency vehicles, hiding locations for Pennsylvania State Police to establish radar speed checks and truck weigh stations, and for the channeling of existing streams or stormwater (in limited areas). These sites are also infrequently used to store rock, soil, and debris during highway reconstruction. Access to median sites is very limited, though as with right of way sites, pull offs could be established for official access, in line with the existing police uses of these sites. In these sites, vegetation with a diameter greater than 4 inches is cleared—according to regulations—40 feet from the lanes of travel. On the ground, however, this regulation is not always closely followed.

Although in densely settled areas there are often no median sites, since east and west bound lanes of travel are divided by only a concrete barrier, the typical median site is rectangular and ranges from 50 to 100 feet in width. Land value and availability at the time of construction seems to control the width of these sites, as in rural areas median sites are typically wider than in suburban or urban areas. As the highway turns and shifts through a landscape, these median sites fluctuate in width and shape accordingly. In most cases, a median site of this width has a level or gentle sloping profile.

Median sites, however, tend to respond dramatically to topography. When the highway is forced to climb a ridge or to pass through a stream valley, westbound and eastbound lanes are typically separated, creating an expansive median site. These sites can range in width from 300 to 900 feet in width, often are uninterrupted for a mile or

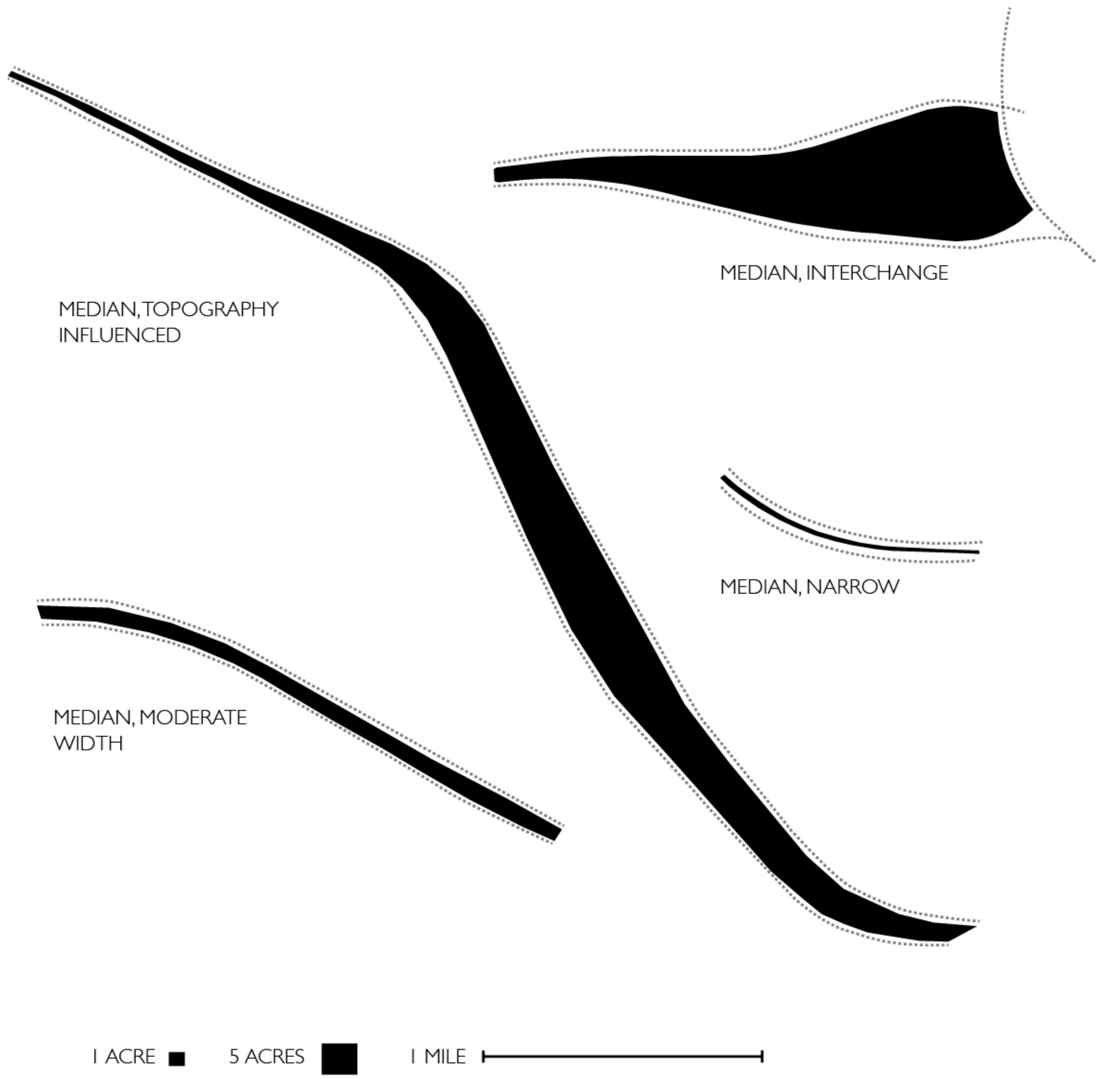


Figure 13 Median Site Categories, I-80. Dotted lines indicate position of traffic on highway.

more, and frequently taper toward each end in response to the surrounding topography. These expansive sites can also be created in response to nearby but not adjacent topography—e.g., if the highway is forced to compress both eastbound and westbound travel through a narrow water gap, the lanes typically separate dramatically nearby to permit the appropriate grade and curvature to move through the gap. In response to other highways, median sites also tend to flare significantly at major interchanges. As the eastbound and westbound lanes separate to accommodate incoming traffic, the median forms a turnip like shape, gradually increasing in width toward the interchange and then being truncated by lanes of merging traffic. On the other side of the interchange, the shape of the median site is reversed; several median sites of this category tend to appear together as a group at larger interchanges.

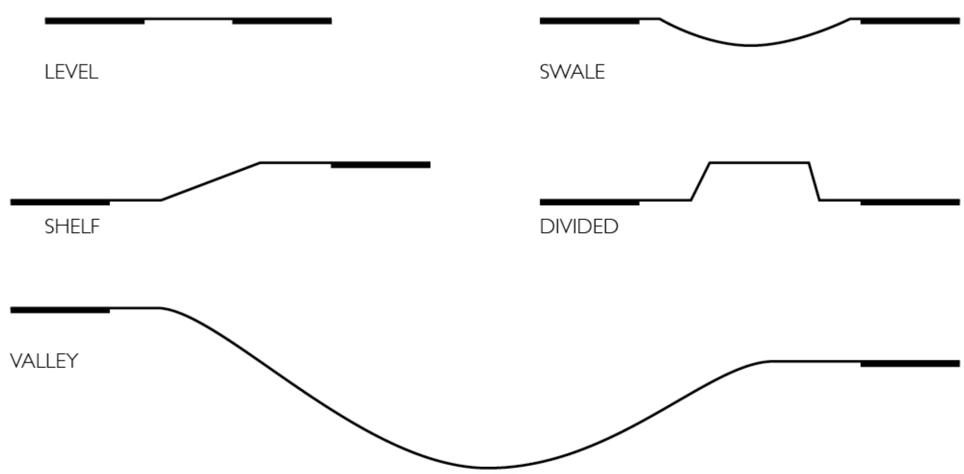


Figure 14 Sectional Variation of I-80 Median Sites. Thick line indicates travel lanes.

Geometric Sites

Geometric sites within the corridor of Interstate 80 are defined as any site that lacks a linear character and is not located between the westbound and eastbound lanes. Sites vary greatly in size but the topography is typically flat or gently sloping. While these sites are not typically programmed, they do occasionally contain intermittent signage or small structures. As with other sites along Interstate 80, access is limited in most cases, perhaps more so in this case because geometric sites are often at exits with an increased volume of traffic. Beyond exits, the reasons that these sites exist are numerous, even sometimes undecipherable, but there are certain patterns that can be observed; these geometric sties, as with linear right of way sites, are nearly always surrounded by a chain link boundary fence, even where the shape of the site is unusual or deviates significantly from the roadway surface.

Along Interstate 80, publically owned rest areas, with picnic areas and restrooms, are intermittently spaced. The area of these sites that are programmed is often only a small percentage of the complete site owned by the state. For example, a picnic area and a cluster of small buildings can be huddled along the corridor, with access from the highway, yet there remains a large percentage of the site beyond this small area. Further, gated access is often available from nearby secondary roads. Similar sites also exist in two other forms. Select rest area sites were designed and land acquired during initial highway planning but the rest area was then never built. Often used as construction staging areas, these sites still maintain access to the highway, though the access is typically gated and overgrown. Similar sites also exist where the initial construction of the highway demanded staging areas for constructing bridges and other structures. Nearly identical sites exist where pits were dug to acquire fill for additional grade changes or where a location was needed to store rock from a necessary rock cut. Similar, yet more

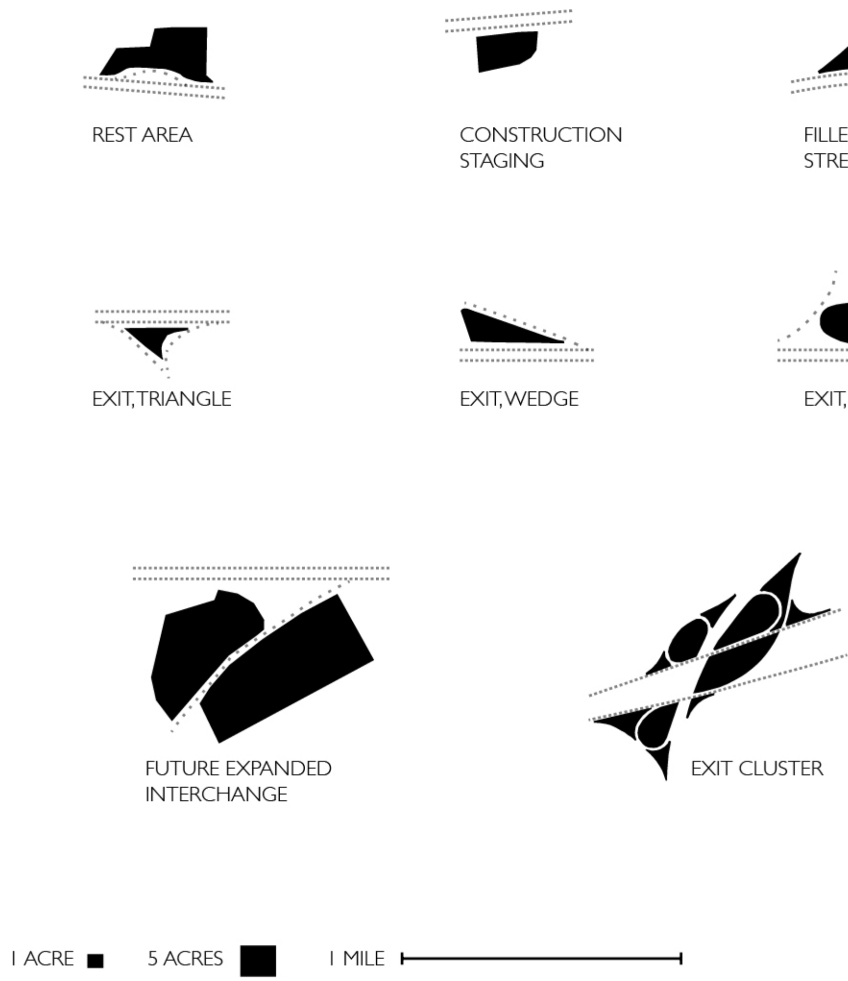


Figure 15 Geometric Site Categories, I-80. Dotted lines indicate position of traffic on highway; less dense dots indicate traffic on a secondary or merging road.

triangular, sites exist where the highway's path intersects perpendicularly with a stream valley. With the necessary increase volume of fill, a wider site along the edge of the highway was acquired to fill the stream valley and install a culvert.

The majority of geometric sites—and the sites with the greatest variety in shape and scale—occur at exits. Because of the variety of travel lanes that merge or overlap, because of the high speeds required for merging and the resulting expansive curvatures, and because of the need to often accommodate grade changes between the interstate and secondary roads—multiple sites exist at each exit. The size and shape of these sites varies depending on local conditions. Circular or oval shapes typically exist where a road or merging lane must make a complete loop. No access is available to these sites. However, traffic moving around them is often relatively slow. Triangular sites remain where fragments of land are pinched between two or more lanes, creating a site with sharp points. Wedged-shaped sites tend to exist at smaller exits where lower speeds can be accommodated. All of these various shapes of sites tend to cluster to form complex arrangements at exits.

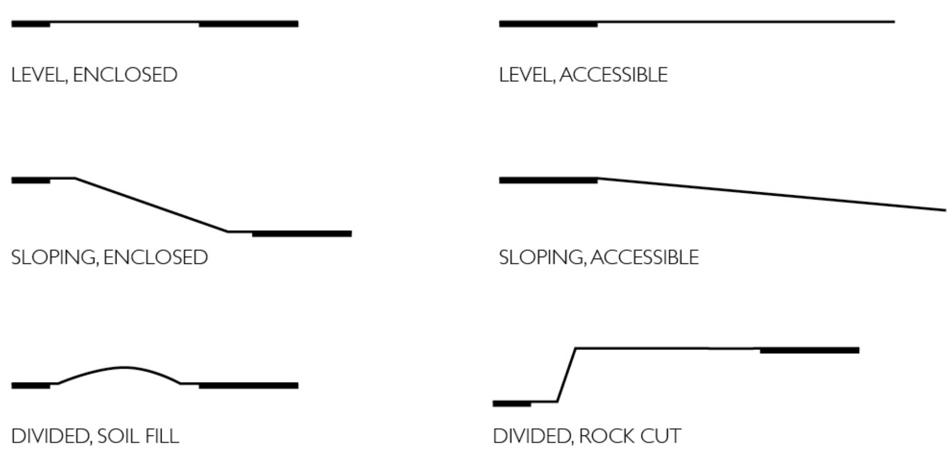


Figure 16 Sectional Variation of I-80 Geometric Sites. Thick line indicates travel lanes; narrow thick line indicates lane of merging traffic—e.g., an exit ramp.

A final and more difficult to identify category results from land that has already been purchased by the state for future interchange projects or lane realignments, or for land acquired for projects that were planned but never built. The difficulty in identifying these sites is that they follow no pattern. Unlike all of the previous sites mentioned, this category of sites is reliant on external knowledge to identify land that has been purchased but is underutilized. These sites, however, present many opportunities for landscape interventions because of their expansive size and available access from secondary roads.

Adjacent Sites

Along the length of Interstate 80 in Pennsylvania, 112 adjacent sites were mapped. These sites were limited to land potentially available to leverage into any proposed landscape intervention within the next 50 years. Sites were also limited to those adjacent to existing exits. At each exit, various socioeconomic factors allowed the influence of the corridor to extend into the surrounding landscape. Therefore, exits are where the corridor most actively interacts with the surrounding landscape in a way that could be leveraged by a landscape designer.

Of these adjacent sites, the most common is vacant or underutilized commercial land at exits. Along the corridor, there are many examples of truck stops, restaurants, or other businesses that have either failed or that occupy only a small portion of a larger site. This creates two types of these sites: a type that is a geometric parcel of land; a type that is a filigree of interstitial spaces between existing businesses. The largest and most common adjacent sites were abandoned or soon-to-be abandoned bituminous strip mines where Interstate 80 crosses the Appalachian Plateau. Although in this study these sites are only mapped where directly adjacent to the corridor, these abandoned sites are abundant in the area of Pennsylvania that the corridor crosses, presenting the opportunity for a much wider landscape intervention based on the access provided by the corridor. An additional type of extractive site, quarries, exists where the highway crosses carbonate bedrock. Although these sites are currently active, there is a chance that within 50 years previously reclaimed land would be available for a landscape intervention.

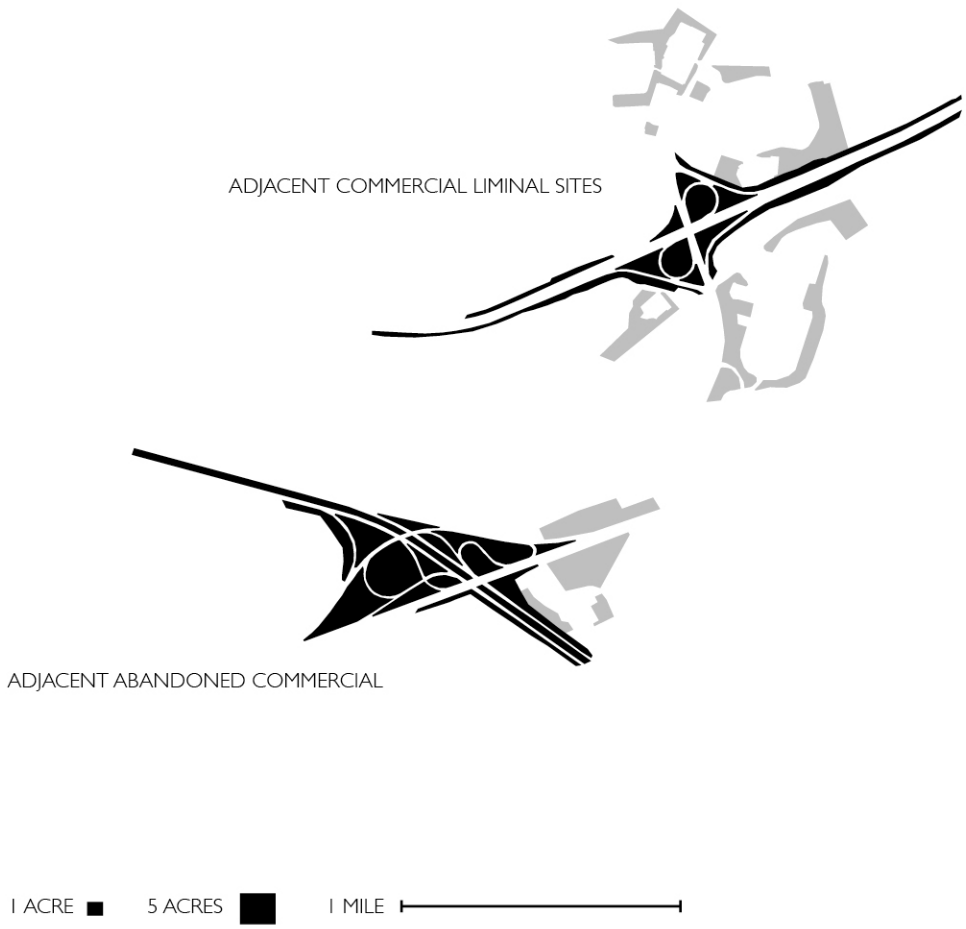


Figure 17 Potential Sites Adjacent to Interstate 80 Corridor. Groupings of sites shown to provide context.

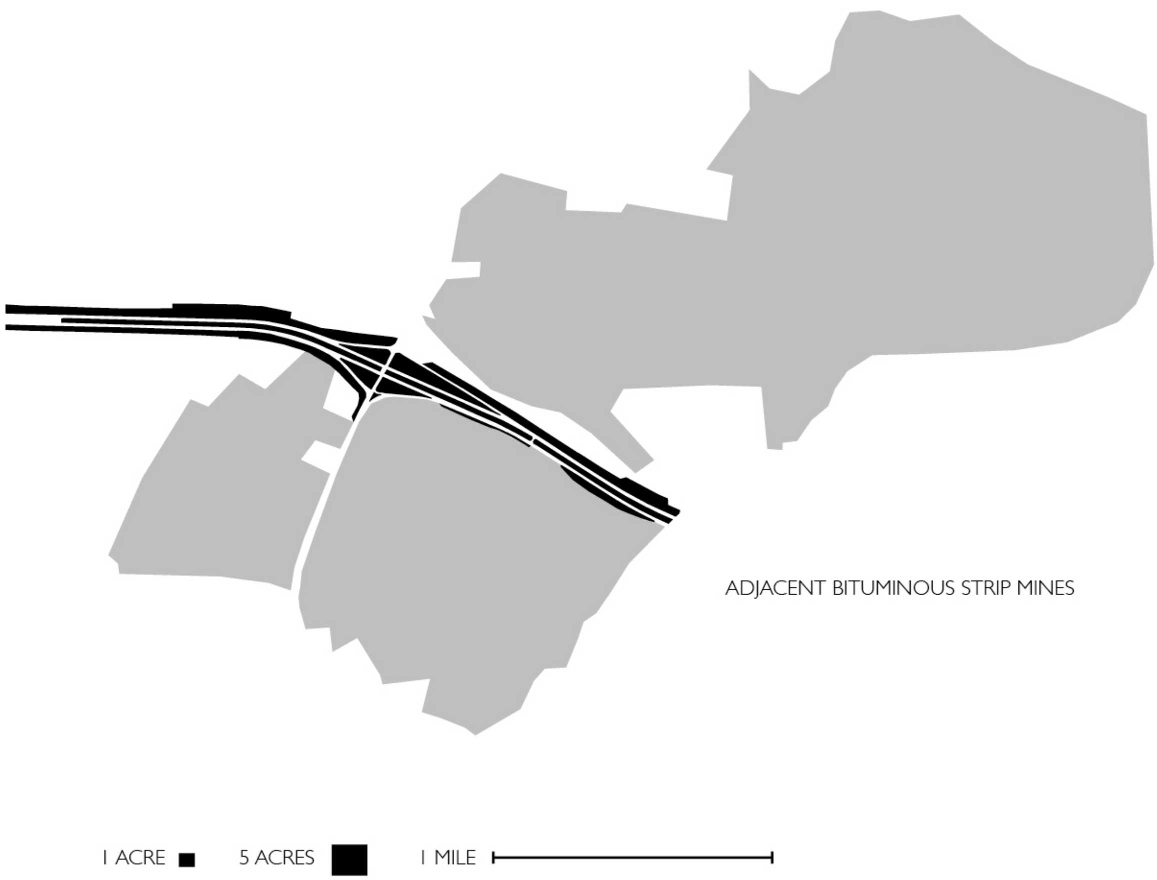


Figure 18 Abandoned Mine Sites Adjacent to Interstate 80. Groupings of sites shown to provide context.

Interstate 80 Site Typology

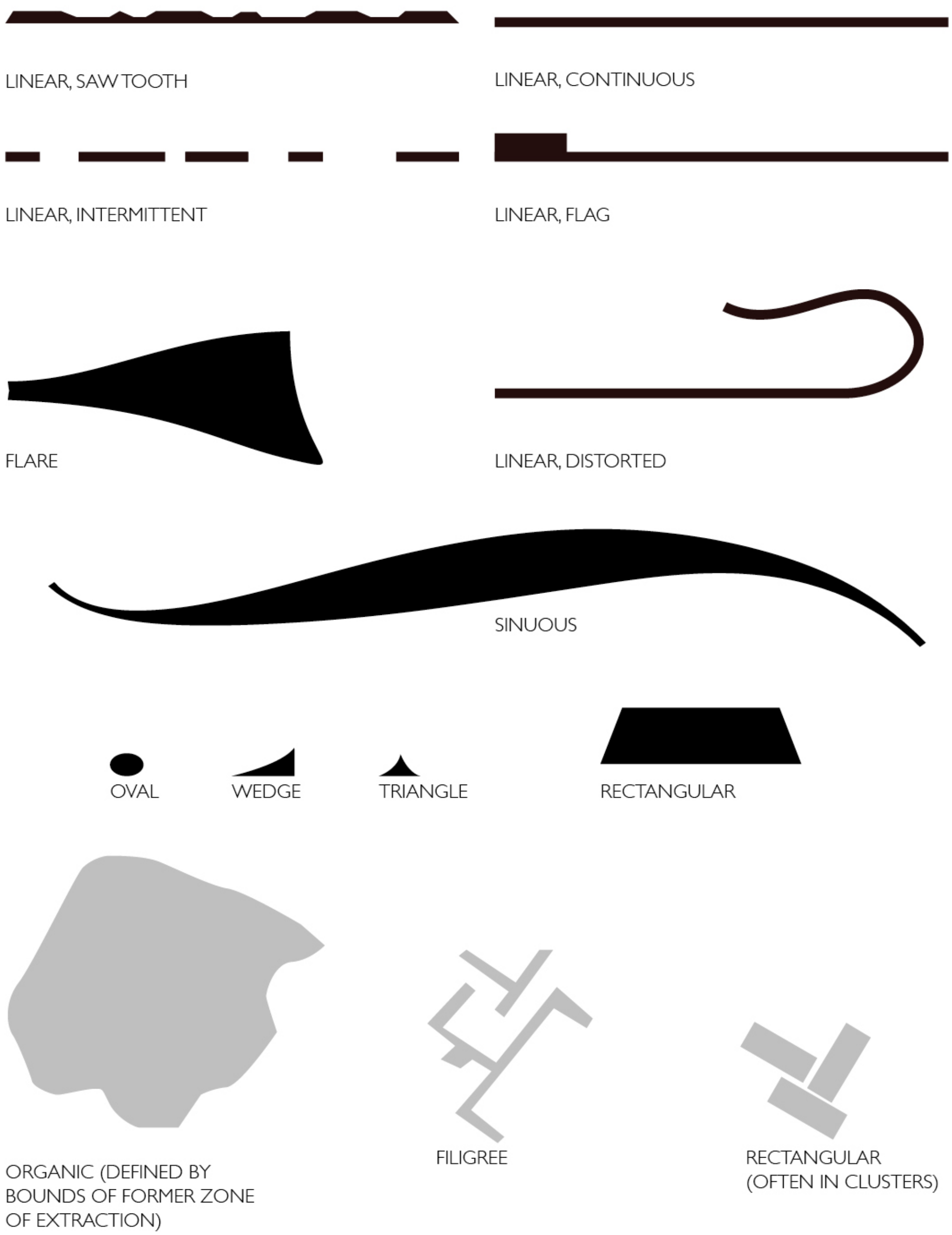


Figure 19 Typology of Sites within I-80 Corridor. Although not to scale, sizes as shown are meant to reflect approximate scale relationships between different types of sites.

Figure 20 Norfolk Southern Railway Eastern Division. (Source: BING Maps)

Site and Corridor Characteristics: Norfolk Southern Railway Eastern Division
(For catalogs, see Appendices B and E.)

Part of a larger Norfolk Southern Railway system that reaches from New York to Florida, from the Virginia coast to the eastern border of Kansas, the Eastern Division of Pennsylvania begins at the Altoona rail yard and terminates at the Delaware River in south Philadelphia. The Eastern Division is approximately 330 miles in length. The railroad route was preceded by a state funded effort in the mid-nineteenth century to create a high volume transportation system between the coast and the interior.[2] Initially a hybrid system of canals, railroads, and inclined planes (to climb the Allegheny Front), the route was eventually purchased by the Pennsylvania Railroad and transformed into a continuous rail route. Before becoming the Norfolk Southern Railway, the route was owned by the Penn Central and Conrail. Although early in the twentieth century the mainline contained, in many places, three tracks, today the line has been reduced to two tracks throughout its length, with the exception of the remaining sidings. The tracks themselves are elevated above the grade of the surrounding area on a thick accumulation of granite ballast.

In contrast to Interstate 80, which largely avoids densely populated areas, the Eastern Division connects from populated area to populated area; the Eastern Division tends to be sited directly through towns, where industrial areas were once active. In many places, the towns were built or expanded due to the arrival of the railroad, as can be seen in the orientation of streets and parcels to the tracks. Now-abandoned sidings also reveal this connection. Further, due to the era of the initial route planning and the limits of locomotive technology at the time, the route tends to follow river valleys. Heading east from Altoona, the route passes through Tyrone before entering the valley of the Little Juniata River, then joining the Juniata River near Petersburg. The Juniata is followed through Mount Union, Lewistown, Mifflintown, Newport—to Duncannon where the route parallels the Susquehanna River to Harrisburg. The route leaves the river and crosses a relatively level valley until joining the Schuylkill River at Reading, which is followed to Philadelphia. If Interstate 80 can be seen as designed through response and significant modification of the surrounding topography, the Eastern Division often abides by the surrounding topography, with the exception of tunnels and rock cuts where required to create a more efficient route.

Along this length of railroad, 187 sites within the right of way were mapped. Although some of these sites reflect the linear character of the corridor, the majority of sites, both in number and size, are found next to populated areas where the railroad created a node of industry that has now been largely abandoned. Complicating the effort to map these sites, over time at certain sites the railroad has constricted its operations, either from reduced volume or from out dated technology, such as water towers, that are no longer required. The response to these constrictions has not always been efficiency, and in many now abandoned sites two or three active tracks inefficiently occupy a much larger site. In mapping these sites, an effort has been made to include inefficient sites where the tracks could be reorganized to allow for more contiguous space. This reorganization is, in many cases, feasible as maintenance and reconstruction of track ballast occurs regularly, allowing an appropriate time to shift tracks.

In contrast to the other two corridors discussed in my research, the topography (at least on the site scale) of the Eastern Division sites is consistently level, owing to the necessity of each site to have rail access to the mainline.

Linear Sites

Linear sites are common along the Eastern Division. It could even be argued that the technical requirements of locomotives and trains demand a corridor of only linear sites, as unlike Interstate 80, no directly perpendicular connections could be made or are even necessary. However, the origin of these linear sites varies greatly and is often unclear, given the long, palimpsestic history of land use and right of way changes. The most common example of a linear site is where a third (or sometimes also a fourth track) has been removed, thus creating a narrow site that parallels the active tracks. A complication is that these extra linear sites are frequently used for vehicular access along the tracks, as shown from satellite photographs by obvious tire tracks. (This observation was confirmed through field visits.) These sites can be quite long, often to the point of connecting together a variety of adjacent sites, both occupied and not. In areas of dense settlement, this connecting ability seems to be particularly strong, given the increase of juxtaposed land uses in urban areas. These linear sites also exist along active tracks where the topography has forced the corridor to slightly widen.

Another variety of linear sites arises from the interaction between the active (or formerly active tracks) and sidings, road crossings, and historic infrastructure. From the active tracks, now abandoned sidings frequently split away to access a former industrial facility. Now abandoned, these sidings sometimes remain intact and unoccupied, often hidden by ruderal vegetation. Where these sites occur in towns or cities, the urban fabric is often intersected by or built around the siding, allowing these sites to connect many different adjacent parcels. At road crossings, there is often a wedge of unoccupied right of way that is wider than where there isn't a crossing. These sites occur in both rural and semi-urban areas, though they tend to be largest in semi-urban areas. (At-grade crossings in urban areas are minimized, thus not creating this type of site.) Because the technology of locomotives that provides motive power on the Eastern Division has changed so significantly since the route's construction, there are sites along the corridor that were originally reserved for an infrastructural purpose that is no longer necessary. Although the origin of these sites is nearly impossible to discern using the method proposed in my research, the pattern of these sites can be seen in satellite photographs, allowing select sites to be discovered and mapped here. The pattern most frequently observed is that of an expansion of the corridor's right of way in an otherwise unexpected area—e.g., not in a town, not at an industrial zone. Some of these sites can be located because the ground is still bare; others must be located by observing how the age and type of vegetation changes adjacent to the corridor. These sites are currently unoccupied.

The largest category of linear site is located within underutilized or abandoned rail yards along the Eastern Division. These sites, which are often a cluster of large sites, tend to be found within populated areas, where a railroad would have had to access an industrial zone or where the railroad would have required significant employee-hours to perform maintenance to passing trains. Declining rail traffic in the mid-twentieth century often created a situation where railroads were no longer able to afford—nor required—the complete area of yards to be active. Following these contractions in yard area, what exists is a complicated weave of active lines, abandoned lines, and empty space. Railroads have not been efficient in this contraction, as mentioned above. The result of this inefficiency is the creation of an archipelago of sites existing within these rail yards.

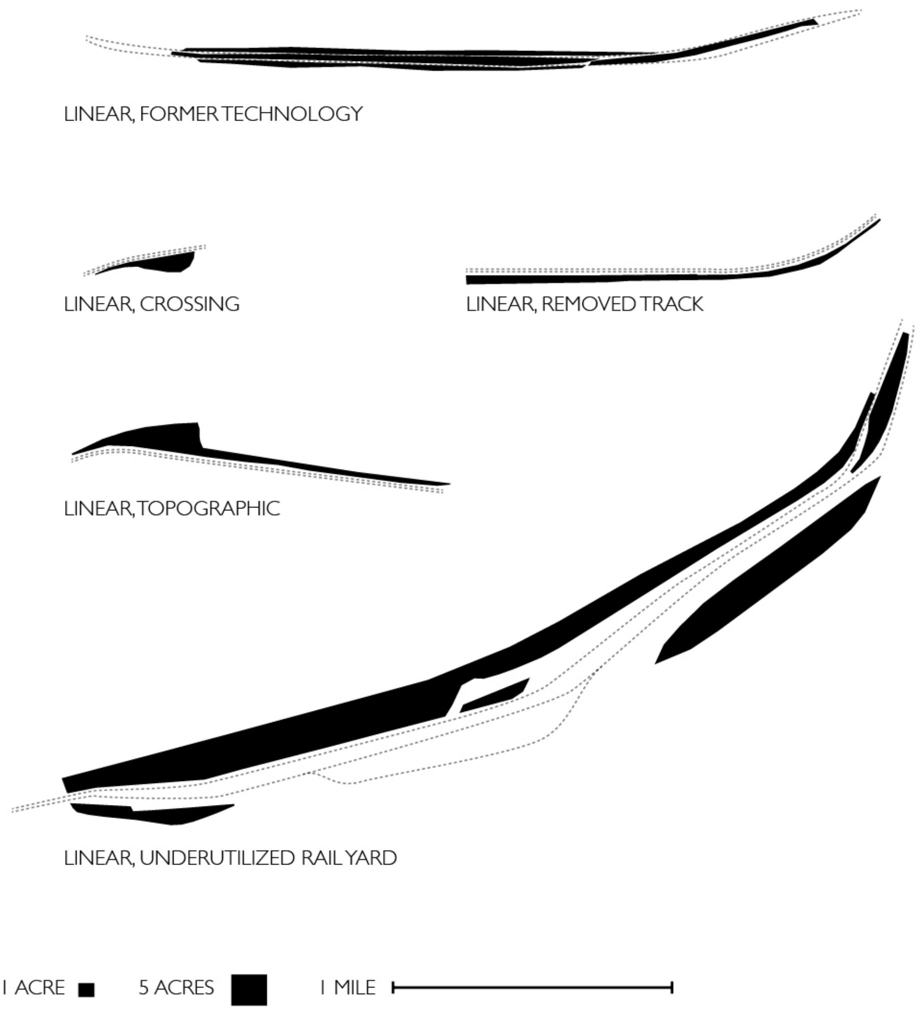


Figure 21 Linear Sites Along Eastern Division of Norfolk Southern Railway. Dotted lines indicate positions of active tracks.

Geometric Sites

Geometric sites are limited to the junction of the mainline and subsidiary lines, either active or abandoned. Much like exits on Interstate 80, these sites are formed on land that is surrounded by the corridor. The exception to this is subsidiary lines that are now abandoned. On the Eastern Division, these sites are clustered in the more populated eastern section of Pennsylvania.

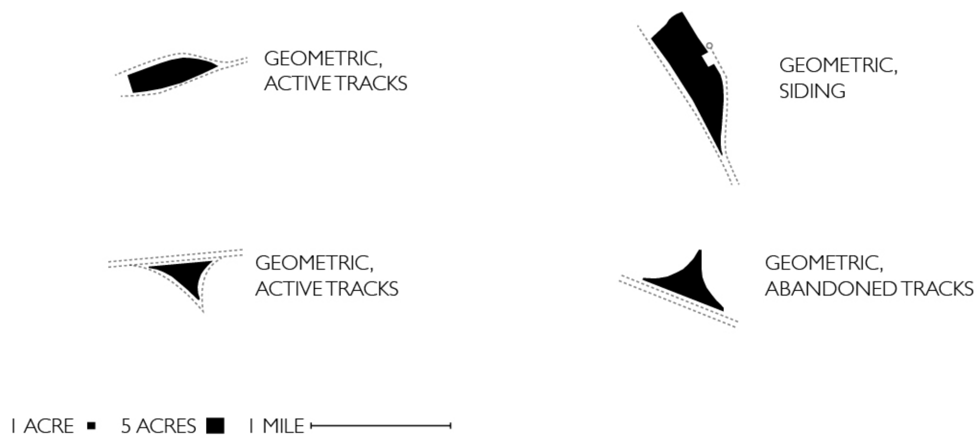


Figure 22 Geometric sites along Eastern Division of Norfolk Southern Railway. Dotted lines indicate positions of active tracks.

Adjacent Sites

Because the landscape surrounding the Eastern Division was often reorganized in order to address the mainline following the railroad's construction, the 160 mapped adjacent sites are all a direct response to the railroad. The railroad was catalytic to the surrounding landscape; this legacy persists.[3] When the route was constructed, parcels adjacent to the route become desirable due to access to shipping. These adjacent sites, then, tend to be post-industrial or extractive. Following the shift to interstate highway shipping, many industrial parcels were abandoned in favor of locations closer to interchanges. However, the pattern is persistent, and what exists today is a string of sites along the Eastern Division corridor of various sizes and shapes. These sites often contain abandoned buildings and ruderal vegetation, and are occasionally used informally by area residents.

Figure 23 Sites Adjacent to Eastern Division Corridor.

Eastern Division Site Typology

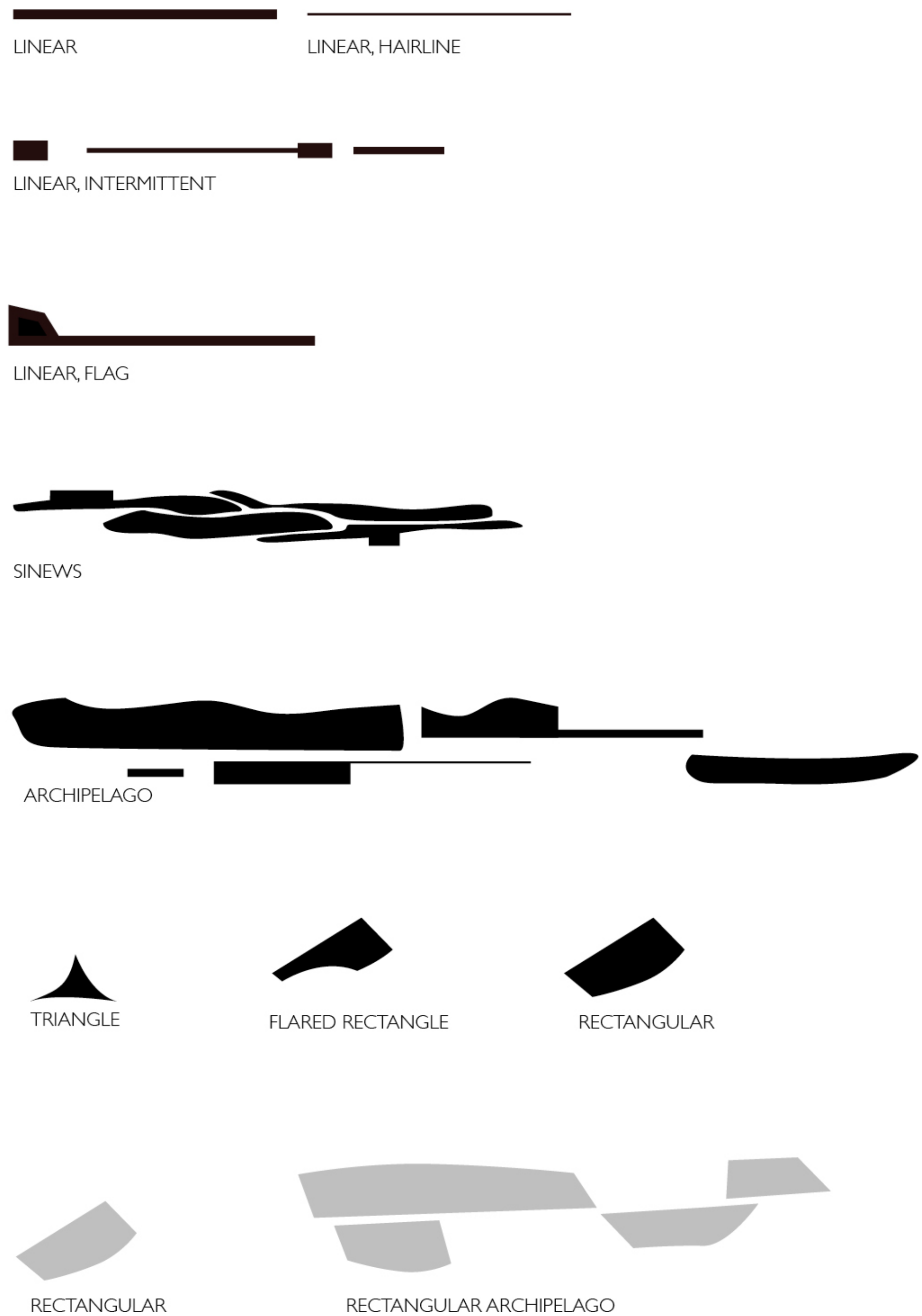


Figure 24 Eastern Division Site Typology

Figure 25 Susquehanna-Roseland Electric Transmission Line. (Source: BING Maps)

Site and Corridor Characteristics:
Susquehanna-Roseland Electric Transmission Line
(For catalogs, see Appendices C and F.)

As opposed to a single corridor, Susquehanna-Roseland is best viewed as a complex of electric transmission lines that convey electricity from an area of production, Pennsylvania, toward an area of consumption, New Jersey.[4] More specifically, the corridor connects the Susquehanna Steam Electric Station (boiling water reactor) along the Susquehanna River, operated by PPL, with a switching station in Roseland, New Jersey. The portion surveyed here extends from Susquehanna Steam Electric Station to the Pennsylvania – New Jersey border.

Referring to this complex as Susquehanna-Roseland is somewhat reductive, as that title is only officially applied to a specific portion of the complex of transmission line that was upgraded from 230kv to 500kv between 2011 and 2014. However, the remainder of the transmission line is not given a publically available title. The various strands of the corridor are often parallel, crossing the landscape while being separated by a mile or more, but infrequently the strands interact or merge. Toward the New Jersey border the strands become a single corridor. Along the approximately 175 miles of corridor length, 145 sites were mapped within the corridor.

Because the transmission lines are aerial—i.e., not resting directly on the ground plane with the exception of towers—this corridor maintains a relationship with the ground plane that differs from both Interstate 80 and the Eastern Division of the Norfolk Southern. The ground plane is largely unoccupied. With the above-mentioned upgrade, the transmission towers along the corridor vary from 100 to 200 feet tall. The corridor demands regulation of the ground plane, primarily to control vegetation that could interfere with the lines themselves or access to the lines. Thus, where the corridor passes through a forest, the forest has been cleared to a specified width, assuring that falling trees will not damage the transmission lines. In places, the corridor crosses through privately owned land that has a land use compatible with the technical requirements of the corridor—e.g., an access road for a suburban neighborhood, a pasture, or a cornfield. In these instances, the corridor only occupies a volume of space above the ground plane. The corridor can be seen as both intermittent and continuous: the method of conveyance is continuous; roads, creeks, and compatible types of land use frequently fragment the ground plane landscape of the corridor.

Susquehanna-Roseland also maintains a different relationship with the surrounding topography. Since the corridor consists of a method of conveyance that is not adversely affected by sharp topographic changes or by variation in the distance between the wires and the ground plane, the corridor responds minimally to the surrounding landscape. Any interaction with the surrounding landscape seems to be incidental.

Approaching a stream valley, the corridor will often span the distance without a route change. Approaching a steep mountain, the corridor will ascend the mountain in the most efficient route possible that allows for the minimal access required for maintenance. It is worth noting, however, that in populated areas the corridor tends to divide surrounding land uses, maintaining a cohesive ground plane corridor through otherwise developed land. The topography of the corridor, due the route's efficiency, can be addressed typologically.

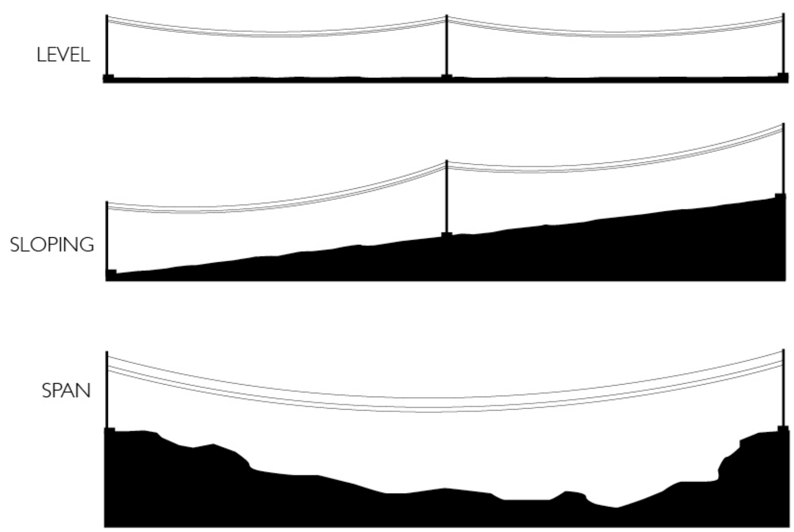


Figure 26 Susquehanna-Roseland Topography Typology

Sites Beneath Transmission Lines

Because the corridor itself crosses private land, through which an easement is purchased, there is minimal extraneous space within the corridor; nearly all sites within the landscape of the corridor are situated beneath the transmission lines. The exceptions are at nodes of ancillary infrastructure. Due to the corridor's efficient route that largely disregards topography, nearly all of these sites are linear, often extending many miles in rural areas without being fragmented; in more densely populated areas or agricultural areas, the landscape of the corridor is frequently fragment by road crossings or land use changes. Because Susquehanna-Roseland is a complex of corridors, not a single corridor, there are often sites where two strands are parallel to each other, with each strand responding independently to the surrounding terrain and land use. Where these strands interact, often at a substation or at a restricted crossing of a river or highway, the corridors often form a complex site that resembles a knot.

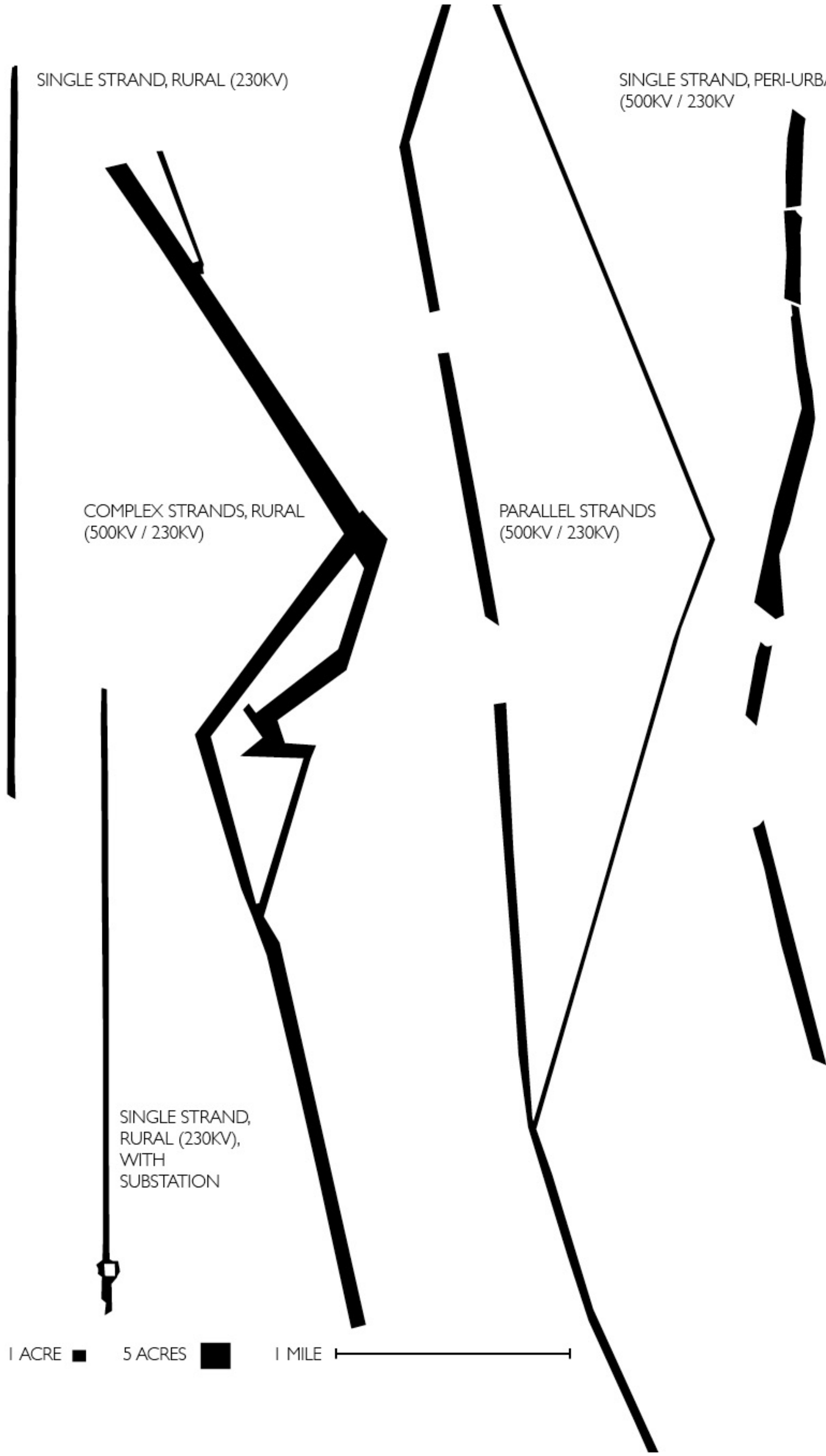


Figure 27 Susquehanna-Roseland Sites Beneath Transmission Lines

Adjacent Sites

As mentioned above, Susquehanna-Roseland has minimal response to the surrounding landscape. The route is planned to be efficient and direct. Where the corridor does interact with the surrounding landscape appears to be largely incidental. Regardless, the corridor does interact with certain types of surrounding landscapes to form sites. As with the previously discussed corridors, the specifics of these sites are dependent upon the geology and various socioeconomic factors in the surrounding area. Of the 20 potential sites mapped along Susquehanna-Roseland, the major adjacent sites result from mothballed power generation sites, from active quarries, and from the spoil piles of abandoned anthracite coalmines.

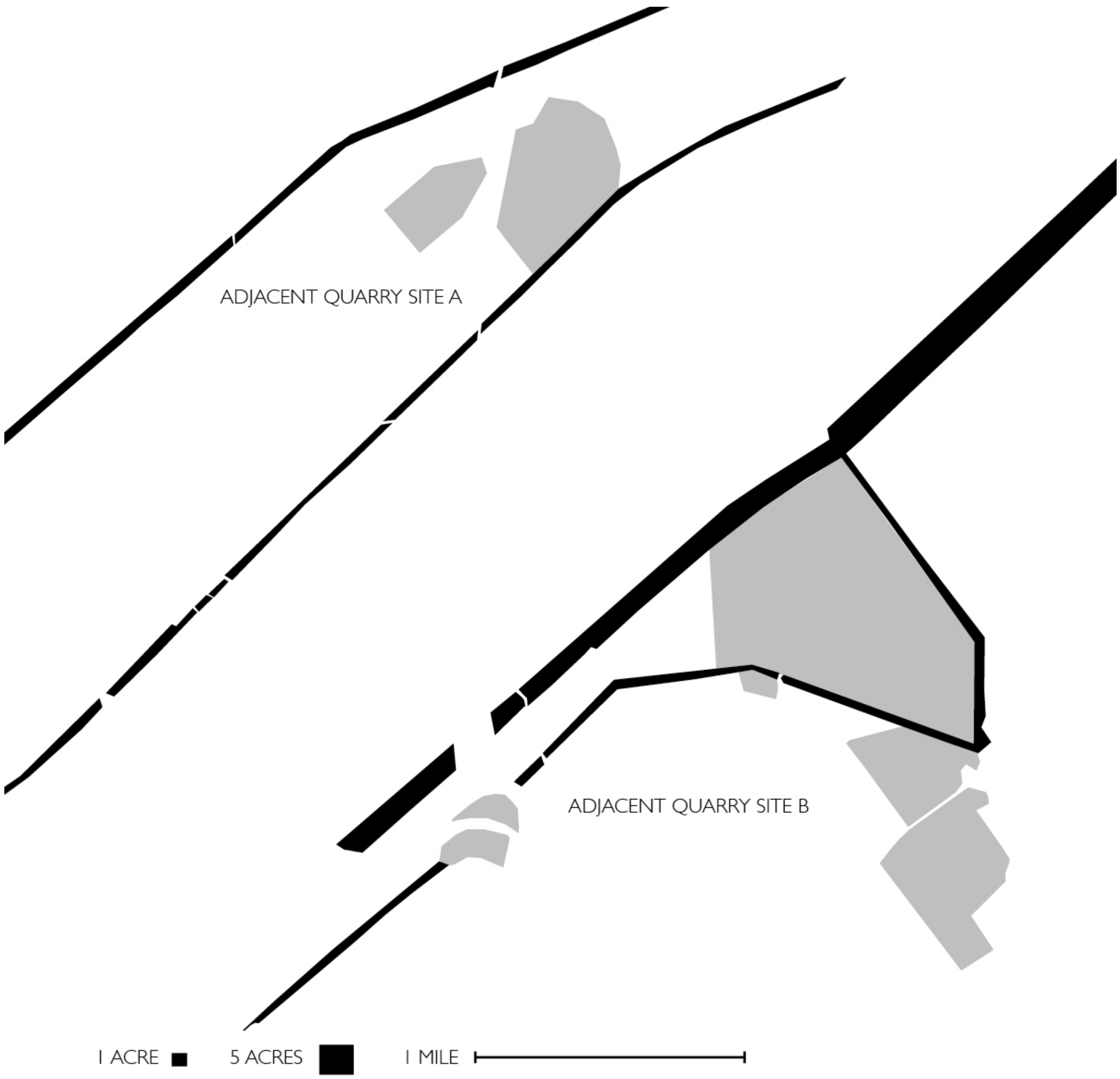


Figure 28 Susquehanna-Roseland Adjacent Sites #1

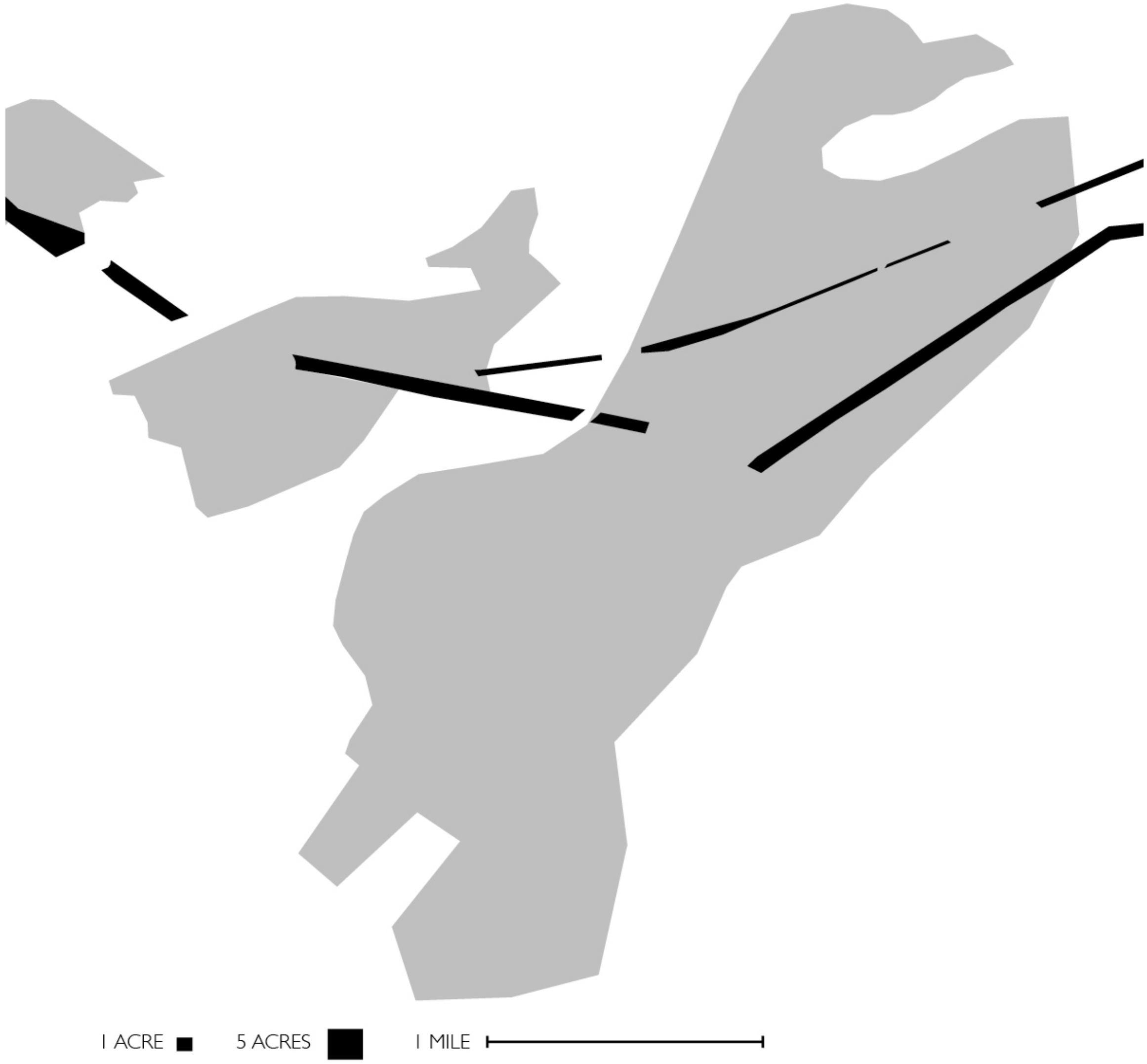


Figure 29 Susquehanna-Roseland Adjacent Sites #2, Abandoned Anthracite Mines.

Susquehanna-Roseland Site Typology

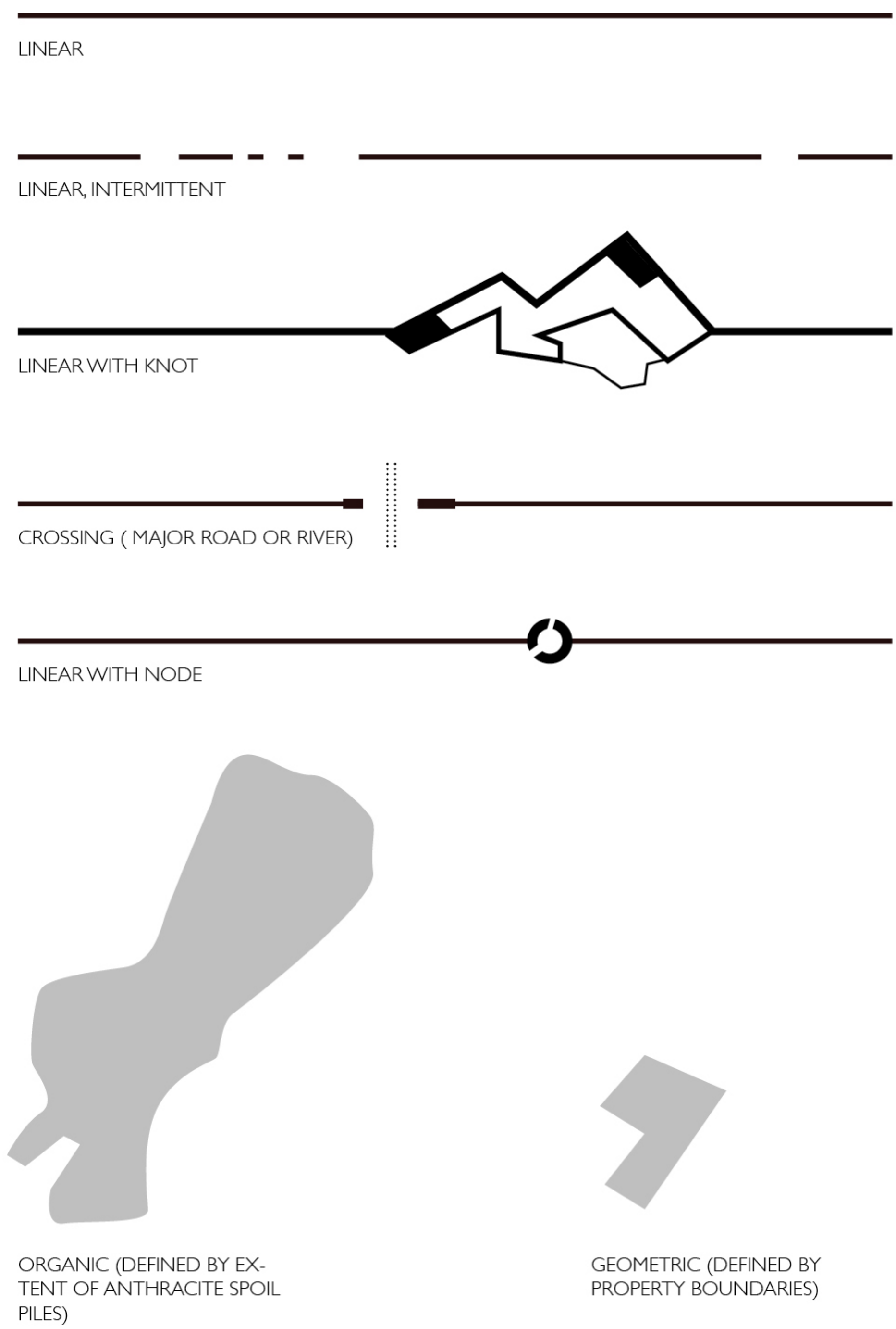


Figure 30 Susquehanna-Roseland Site Typology

[1] Although research into the specifics of spatial perception at highway speeds appears to be lacking, see Shaffer, Maynor, and Roy, "The Visual Perception of Lines on the Road."

[2] Albert J Churella, *The Pennsylvania Railroad, Volume 1: Building an Empire, 1846-1917* (Philadelphia: University of Pennsylvania Press, 2013). Also see William Bender Wilson, *History of the Pennsylvania Railroad Company: With Plan of Organization, Portraits of Officials, and Biographical Sketches* (Philadelphia: H. T. Coates & company, 1899).

[3] John R. Stilgoe, *Metropolitan Corridor: Railroads and the American Scene* (New Haven; London: Yale University Press, 1985).

[4] Specific information for this corridor seems to be unavailable through the U.S. Energy Information Administration (EIA), either because of copyright information (presumably because of the GIS data used to trace the corridor) or because of security concerns. Regardless, there seems to be no specific title for this complex of corridors; Susquehanna-Roseland, the proper title for a recent expansion of this corridor, is here used to designate the entire corridor.

Chapter Five:
Situation: Site and Corridor Experience

Examining the site and corridor experience of the three cases studied in my research is best facilitated through a return to mid-twentieth century ideas regarding the design of interstate highways, specifically the work of Boris Pushkarev.[1] Pushkarev argued for designers to be aware of both the internal and external form and experience of highways—i.e., awareness of how someone driving along the corridor experienced the design; how someone outside of the corridor experienced the design. Two other nearly contemporaneous works later built on Pushkarev's ideas: *The View From the Road* argued for an inward and outward perspective of highway design;[2] *Freeways* argued for the form of highways to be considered both along the corridor and in the corridor's placement through a developed area.[3] In *Freeways,* Halprin also argued for designing highways as "large-scale choreography."[4]Although these ideas were only minimally applied during the construction of the interstate highway system, they present appropriate categories to study the points of contact between people and each of the corridors studied here. These points of contact are critical. When studying how the landscapes of infrastructure might be designed, these points dictate key areas and moments of design potential. Beyond the corridor itself, these points of contact are here also studied in sites adjacent to the corridor that have the potential to be leveraged into any proposed landscape intervention. Further, the category of motion is introduced into this analysis,[5] as corridors are often experienced, either internally or externally, in motion. Although motion is more relevant to Interstate 80 and the Norfolk Southern, even Susquehanna-Roseland can be experienced, at certain points, through motion.

Site and Corridor Experience: Interstate 80

1) Linear Median (Internal / Motion)

Figure 31 Linear Median Diagram. Dotted lines indicate direction and approximate speed of travel.

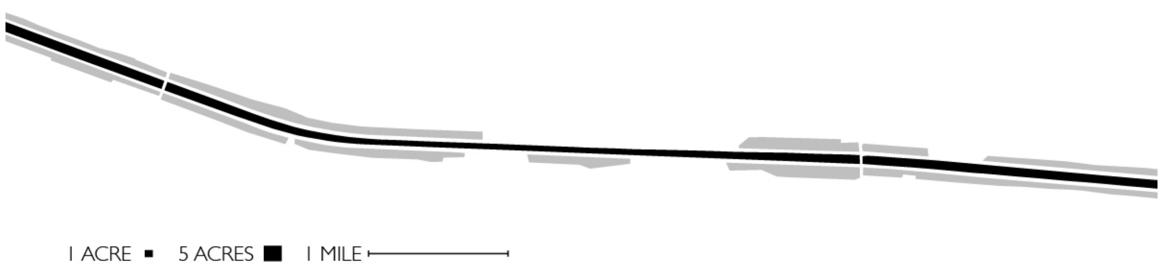


Figure 32 Linear Median Site Condition. Median sites presented in black. Grey sites presented for context.

Although frequently divided by access roads, median sites that are narrow and extend for significant distances are experienced as a ribbon of land between opposing lanes of traffic. They are not, then, experienced as a single site but as a continuous immersion. Given interstate highway speeds, these sites are most likely more intensely experienced from a distance—i.e., further down the road. This ribbon of land, however, is viewed differently as the curvature and grade of the highway changes. Therefore, there are instances when a person in an automobile has a sweeping view of the median and there are instances when that person is in an elevated position above the median, looking across. When opposing lanes are built at different elevations, one set of lanes might look across a median while another set of lanes looks up at a median.

2) Linear Right of Way (Internal / Motion)

Figure 33 Linear Right of Way Diagram. Dotted lines indicate direction and approximate speed of travel.

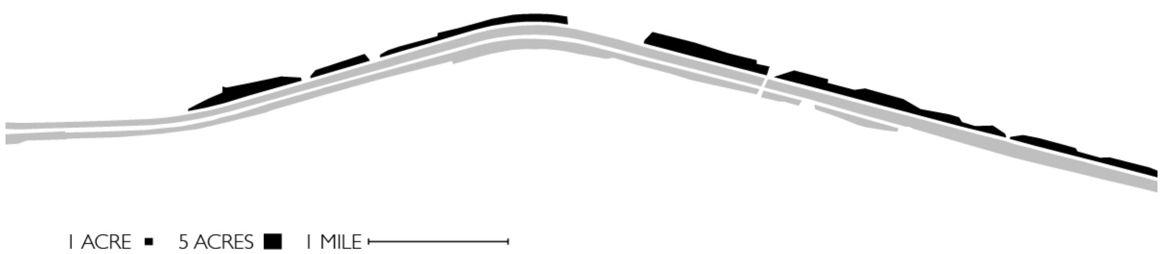


Figure 34 Linear Right of Way Site Condition. Right of way sites are presented in black; grey sites are presented for context.

While sharing many of the same experiential aspects as median sites, right of way linear sites contain more variety and more interruptions along their length, though many extend for over a mile. If median sites can be viewed as legato, thee various depths and interruptions of right of way sites create a staccato rhythm. Motion is also key to the experience of these right of way sites, though they are primarily viewed in one direction of travel. Sites indicated in Figure 34 depict only right of way sites greater than 40 feet in width; there is a continuous, though narrow, band of land that lines the entire right of way along the interstate that is not depicted. Right of way sites frequently contain topography that either tilts the ground plane toward or away from travel lanes.

3) Wide Median (Internal / Motion)

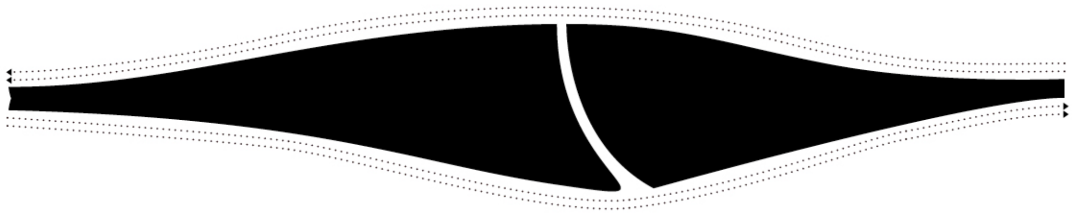


Figure 35 Wide Median Diagram. Dotted lines indicate direction and approximate speed of travel.

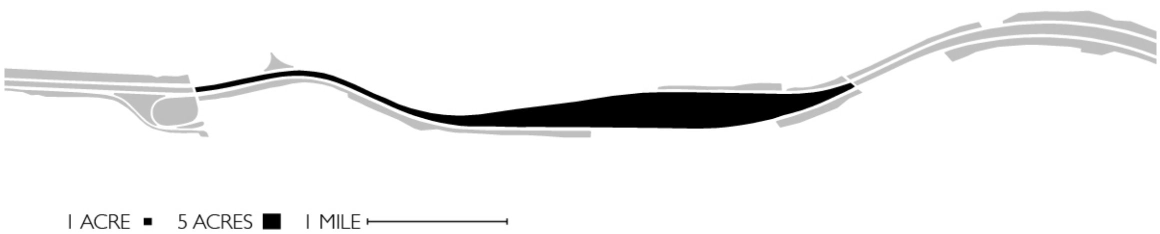


Figure 36 Wide Median Site Condition. Median sites are presented in black; grey sites are presented for context.

Wide median sites, typically a response to the presence of a mountain or a narrow stream valley, offer a separation of opposing lanes of traffic. This separation creates a large site with a substantial core that is often not visible from the travel lanes. The degree of visibility is influenced by the topography. Where the median site contains a stream valley or contains fill related to highway construction, travel lanes are often elevated above the site, creating constant, sweeping views into the site. Where the median site is necessitated by steep topography, the median site often remains level to or elevated above travel lanes, limiting visibility. However, the edge of a wide median site is an edge condition that presents constant visibility from the travel lanes.

4) Exit, Ramp (Internal / Motion)

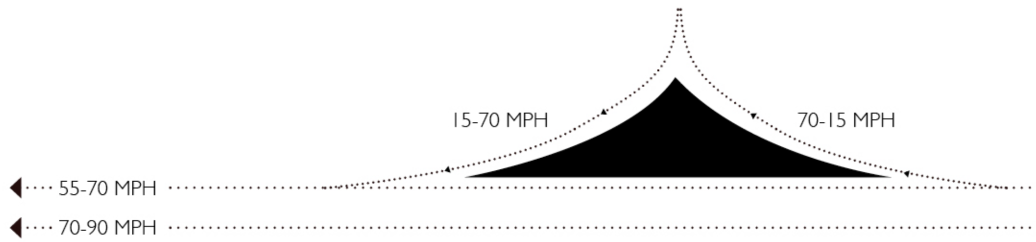


Figure 37 Exit Site From Ramp Diagram. Dotted lines indicate direction and approximate speed of travel.

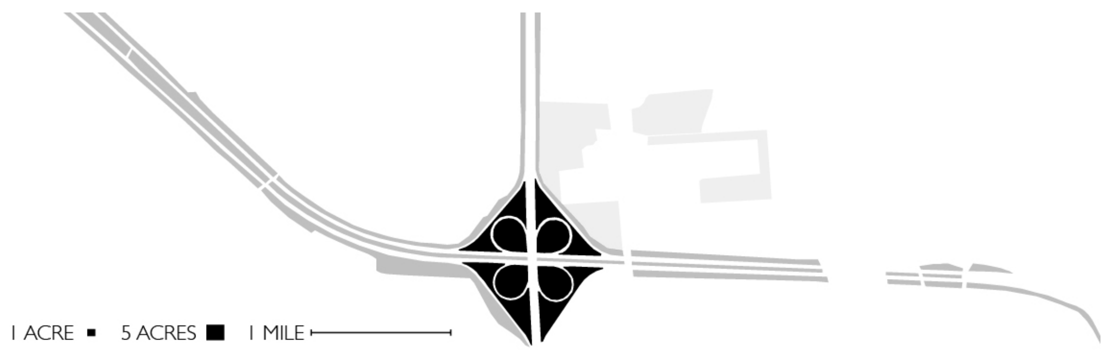


Figure 38 Exit Site From Ramp Site Condition. Median sites are presented in black; grey sites are presented for context.

When viewed from the exit ramps, sites that exist near exits present thresholds, both to the highway, when entering, and to the surrounding landscape, when exiting. These sites are moments of transition, surrounded by cars that are accelerating or decelerating, changing from the condition of the linear highway to the complexity of the surrounding landscape. These sites, then, are often locations of punctuation on a journey along an interstate. Further, given the grade and speed requirements of transitioning from highway speeds to secondary road speed, exit sites often involve rapid changes of grade and moments of rotation, where a car circles, fully or partially, around the edge of a site. These movements intensify and activate the experience of the site.

5) Exit, From Interstate (Internal / Motion)

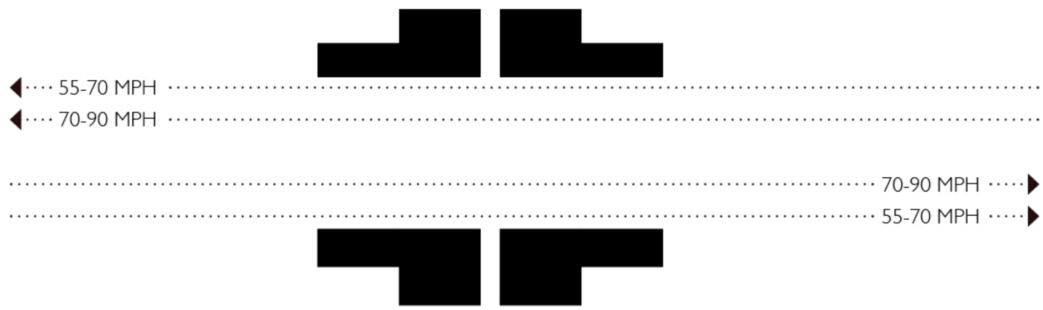


Figure 39 Exit Site From Interstate Diagram. Dotted lines indicate direction and approximate speed of travel.

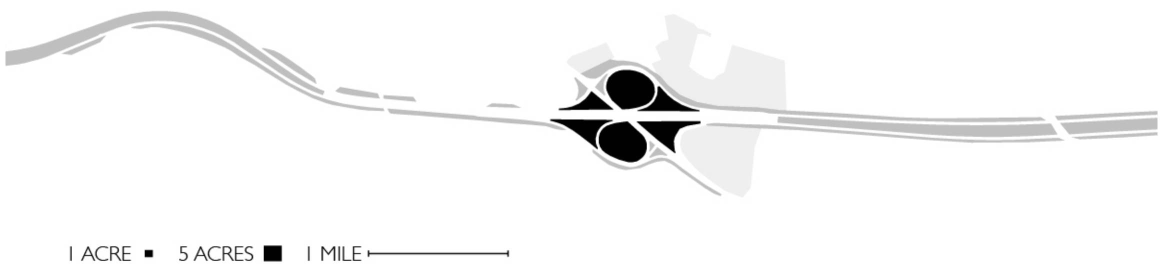


Figure 40 Exit Site From Interstate Site Condition. Median sites are presented in black; grey sites presented for context.

Viewed from the travel lanes of the interstate, exit sites also act as punctuation. However, since the travel lanes pass through the center of a complex of exit sites, the experience of these exits is a different variety of punctuation than when experienced from an exit ramp; these sites are relief from the largely linear character of the interstate. There is still, however, a degree of immersion, as the travel lanes pass through the complex of sites. Because there is little acceleration or deceleration at these sites, any potential intervention should be viewed within the amount of time it takes a car to move through these areas at highway speeds—a length of time that varies greatly depending on the spatial arrangement of a specific exit.

6) Abandoned Bituminous Strip Mine (Internal / Motion)

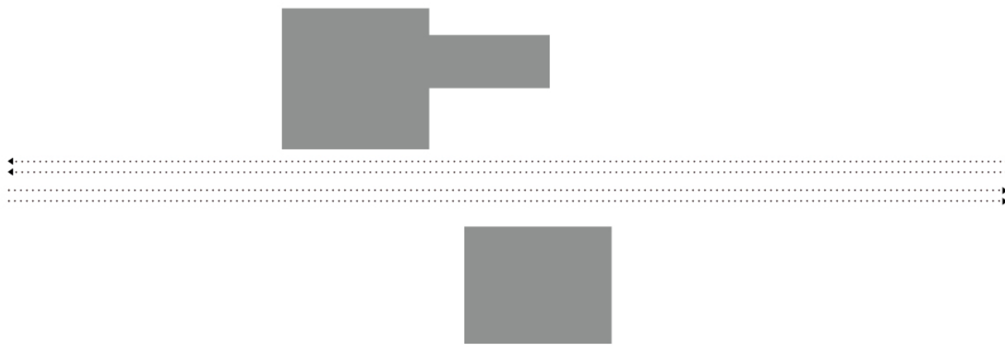


Figure 41 Adjacent Bituminous Strip Mine Diagram. Dotted lines indicate direction and approximate speed of travel.

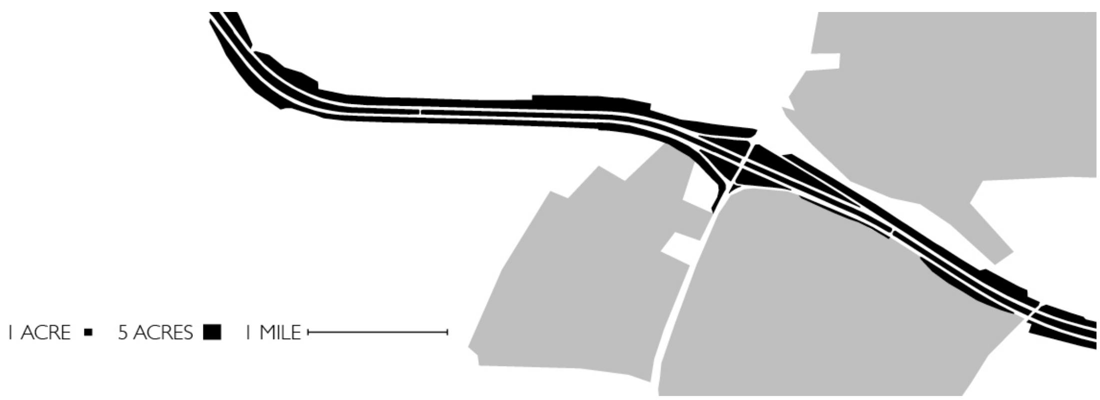


Figure 42 Adjacent Bituminous Strip Mine Site Condition. Gray sites are strip mines; black sites are within I-80 right of way.

Now-abandoned bituminous strip mines adjacent to exits along Interstate 80 are often elevated above the travel lanes, offering drivers on the interstate views of these sites. Because these sites are further from the travel lanes than, say, exit sites, they are visible for a longer duration. However, given the distances, what is placed on those sites would require a different scale to be legible from the highway. A conspicuous element of these sites is that many offer an unusually diverse and manipulated ground plane; the very materiality of their surface conveys the geologic and extractive history of the surrounding landscape.

7) Rest Areas (Internal / Stationary)

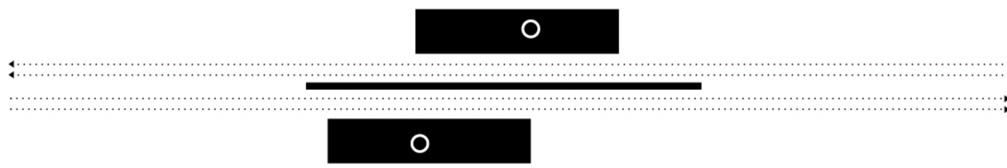


Figure 43 Rest Area Site Diagram. Dotted lines indicate direction and approximate speed of travel. White circles indicate potential areas of occupation.

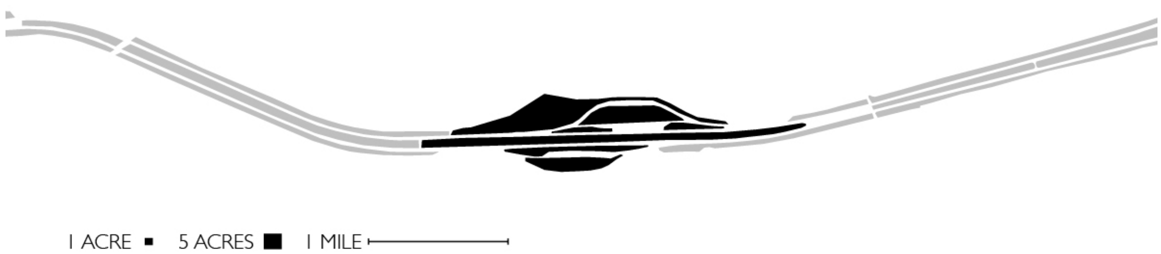


Figure 44 Rest Area Site Condition. Rest area sites are presented in black; grey sites presented for context.

As a pause in the otherwise constant motion of the interstate, rest areas are the only interstate sites typically experienced from a stationary perspective. These sites are a pause in constant motion. These sites, therefore, have the potential to occupy a larger portion of a driver's experience of an interstate. Much like exits, these sites are punctuation. Beyond the rest area site itself, a driver has a view of the surrounding rest area and the adjacent median sites; looking across traffic at the median site, there is an interaction between the moving traffic and the site itself. These sites are one of the few places where the spatial reality of the technical requirements of the corridor is experienced without distortion from motion.

8) Linear Right of Way (External / Motion)

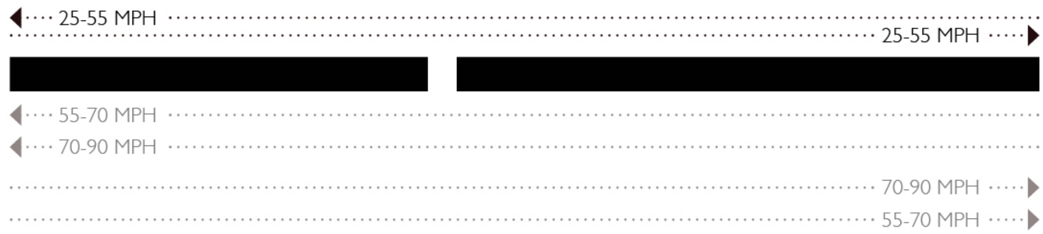


Figure 45 Linear Right of Way External View Site Diagram. Dotted lines indicate direction and approximate speed of travel, with greyed-out lines indicating interstate traffic and black lines indicating traffic on secondary road.

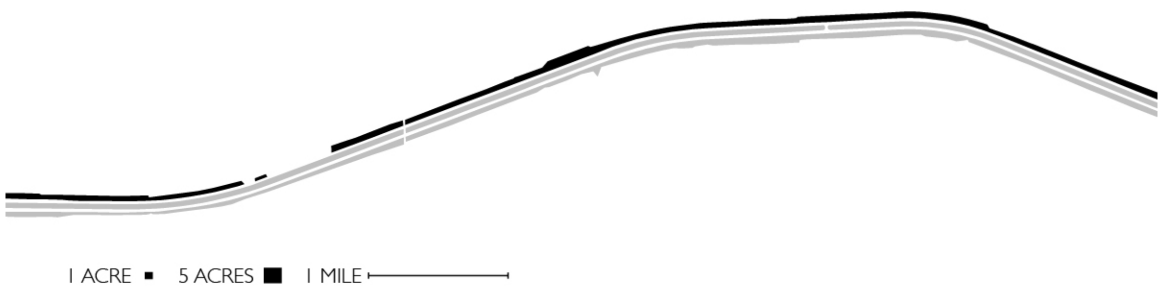


Figure 46 Linear Right of Way External View Site Condition. Right of way sites are presented in black; grey sites presented for context.

Where Interstate 80 displaced an existing secondary road, the secondary road was often rerouted to parallel the travel lanes of the interstate. Where secondary roads parallel the interstate, they offer a continuous view of the interstate's right of way. These sites can extend for miles. Depending on the topography and the fill response during interstate construction, these right of way sites are typically located below the secondary road or are sloping upward from the secondary road. This relationship is important, as visibility of the right of way is reduced with a ground plane that slopes downward and is enhanced by a ground plan that slopes upward. Right of way sites from this perspective also offer a visual screen between interstate traffic and the motion of cars on the secondary road—a relationship that most likely changes depending on the time of day, weather, and season.

9) Interstate Crossing (External / Motion)

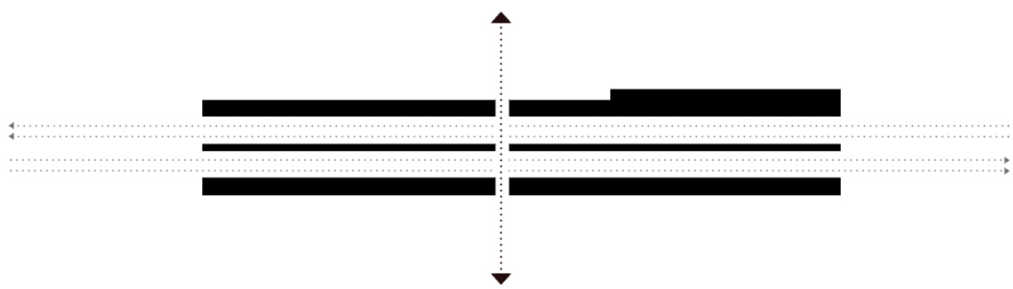


Figure 47 Interstate Crossing Site Diagram. Dotted lines indicate direction and approximate speed of travel. Secondary road indicated by vertical line with arrows.

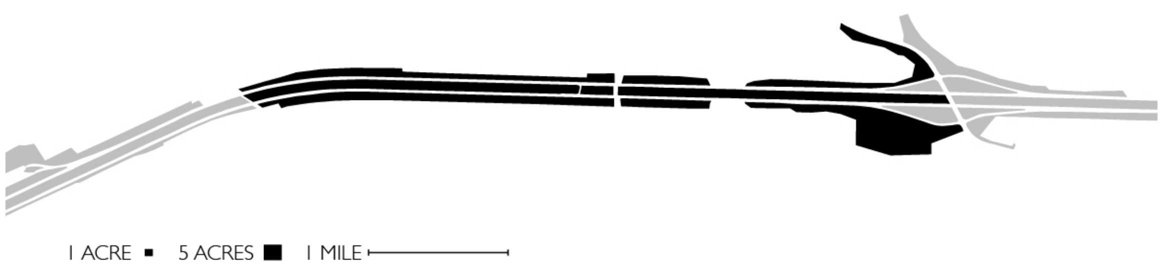


Figure 48 Interstate Crossing Site Condition. Visible sites are presented in black; grey sites are presented for context.

Secondary or tertiary roads often cross Interstate 80, both on bridges and through underpasses. Where these roads intersect the interstate, they offer a driver a cross-sectional view of the interstate's landscape. While median and right of way sites appear narrow while moving on the interstate or while moving on parallel secondary roads, these sites appear to be much wider when viewed while traveling perpendicularly. In driving across these crossings, a sequence of experiencing sites and experiencing moving traffic is established.

10) Exit Crossing—Secondary Road (External / Motion)

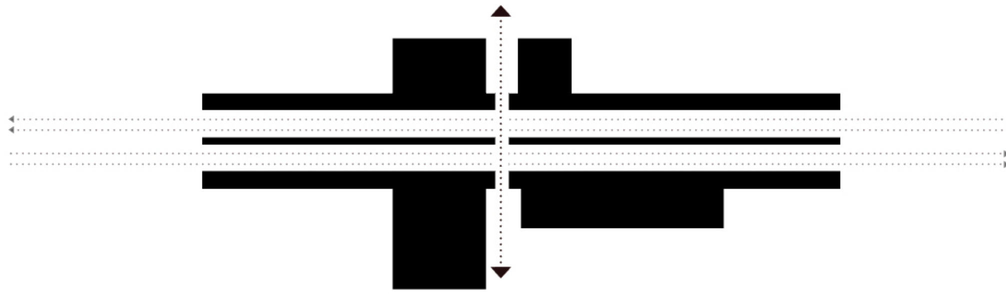


Figure 49 Exit Crossing Site Diagram. Dotted lines indicate direction and approximate speed of travel. Secondary road indicated by vertical line with arrows.

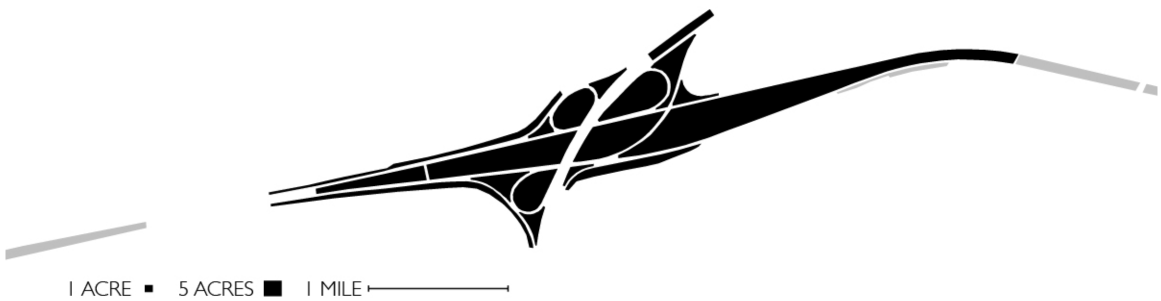


Figure 50 Exit Crossing Site Condition. Visible sites presented in black. Grey sites presented for context.

Exit crossings—where secondary roads perpendicularly cross the interstate at an exit—present a similar condition as the interstate crossing category mentioned above. However, although the idea of a spatial cross section is also applicable, in this example the scale has increased dramatically. The area of sites that a driver will pass while moving through an exit is much larger, and many of these sites extend further along the right of way of the secondary road. Further, the range of site shapes is greater, creating a wider variety of interactions between moving cars and the sites. The duration of contact between a driver and these sites is also increased compared to the above category.

11) Adjacent Commercial Sites (External / Motion)

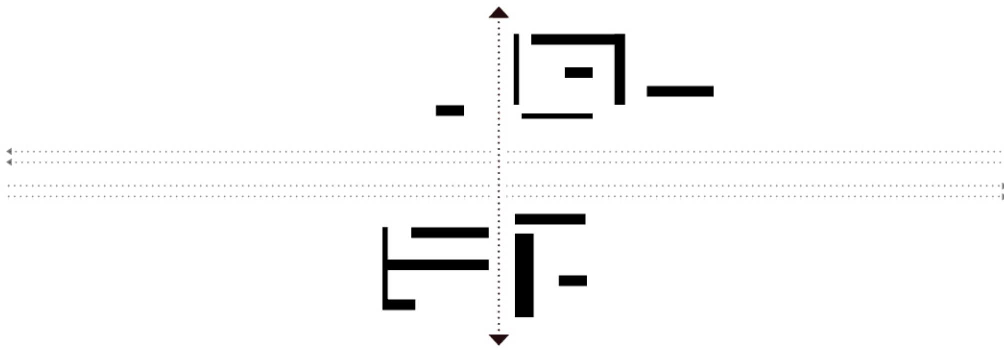


Figure 51 Adjacent Commercial Site Diagram. Dotted lines indicate direction and approximate speed of travel. Secondary road indicated by vertical line with arrows.

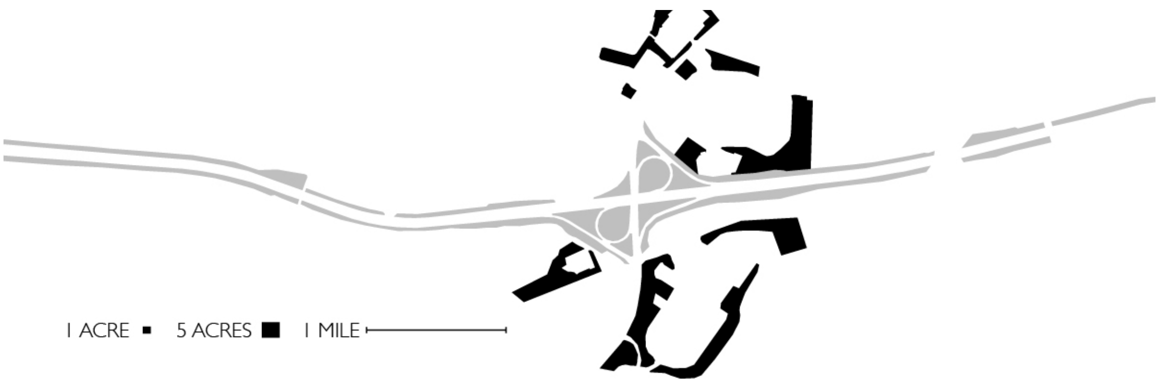


Figure 52 Adjacent Commercial Site Condition. Black sites represent adjacent commercial sites; grey sites provided for context.

Commercial sites adjacent to the Interstate 80 corridor are typically experienced as flashes of spaces as drivers on secondary roads pass through the area. Buildings, signs, and other traffic interrupt constant views of the sites, though the sites offer great variety and surprise through their fragmented condition. Parallax is an important concept in consideration of these sites, as when they are experienced in constant motion the composition of the sites is rearranged according to the perspective of a driver. These sites are part of the transition zone that exists at exits to mediate between the condition of the interstate and the condition of the surrounding landscape. Placing these sites in a wider landscape, they are often incongruous in rural areas.

12) Abandoned Bituminous Strip Mine (External / Motion)

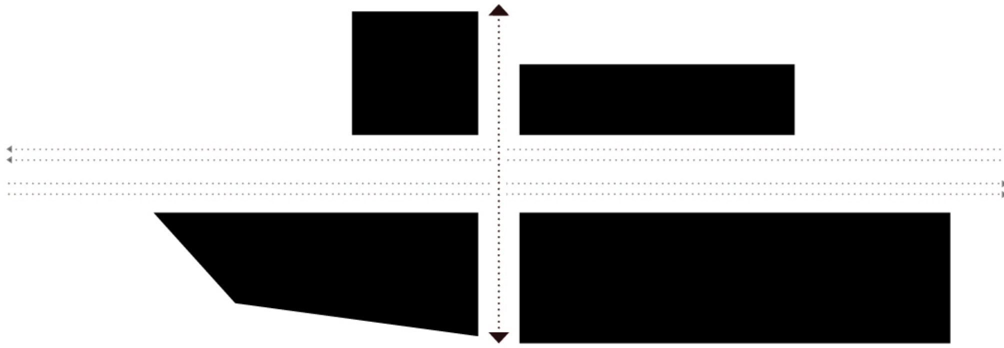


Figure 53 Adjacent Bituminous Strip Mine Site Diagram. Dotted lines indicate direction and approximate speed of travel. Secondary road indicated by vertical line with arrows.

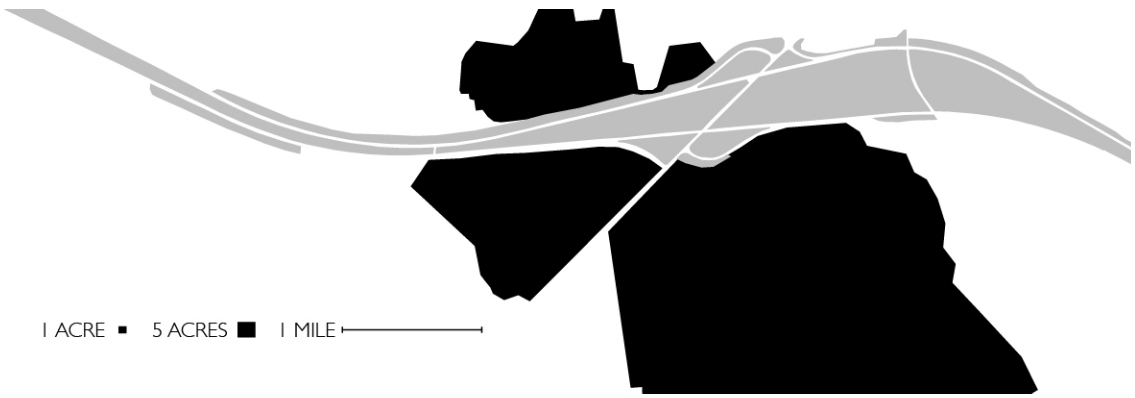


Figure 54 Adjacent Bituminous Strip Mine Site Condition. Black sites represent adjacent commercial sites; grey sites provided for context.

Although abandoned bituminous strip mines exist in a similar pattern to the commercial sites mentioned above, these sites present a different experience for drivers on secondary roads. While commercial sites present fragments, abandoned strip mines present an extended edge that prolongs the visual contact between road and site. Strip mines immerse the secondary road within the site. This extended contact exists simultaneously with the visual contact that exists between drivers on the interstate have with the strip mines while moving through the corridor. These sites, then, represent the most significant focal points where the geologic and economic conditions of the surrounding landscape affect the corridor and nearby residents.

13) Adjacent Commercial Sites (External / Stationary)

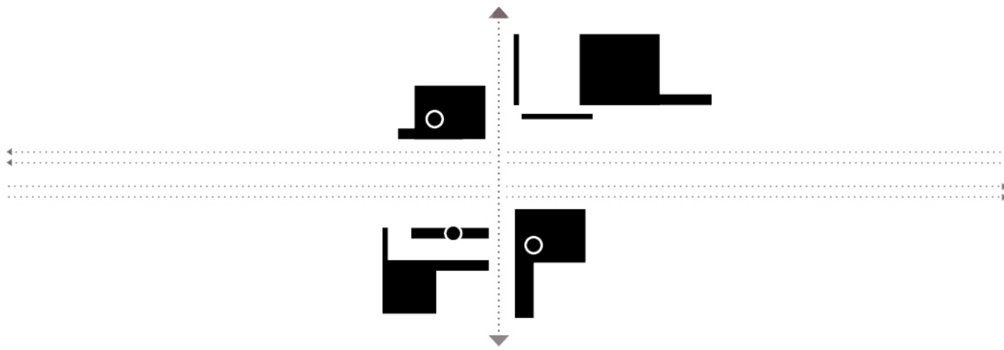


Figure 55 Adjacent Commercial Site Diagram. Dotted lines indicate direction and approximate speed of travel. Secondary road indicated by vertical line with arrows. White circles indicate potential areas of occupation.

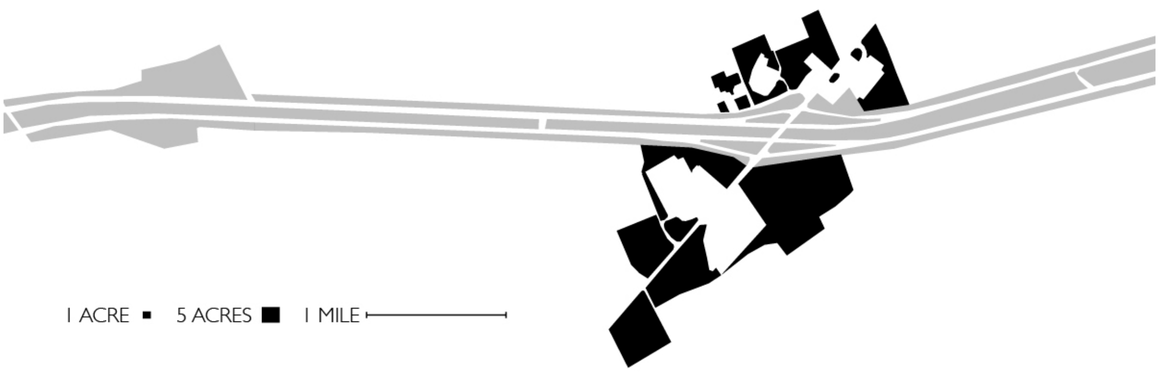


Figure 56 Adjacent Commercial Site Condition. Black sites represent adjacent commercial sites; grey sites provided for context.

Adjacent commercial spaces also provide an opportunity for sites along the corridor that can be inhabited by nearby residents and by passing motorists who leave the interstate. As these sites are the space between buildings and the vacant lots from failed commercial ventures, they present fragmented and heterogeneous sites; however, these characteristics mean that the sites present a wide variety of niches to be inhabited through various programs—i.e., although the sites are not cohesive parcels, the prevalence of edge conditions, the variety of slopes, the diversity of sizes and shapes could allow these areas to accommodate many different programs. Further, there is an adjacency to the corridor without direct, potentially conflicting contact.

Site and Corridor Experience: Norfolk Southern Railway Eastern Division

1) Removed Tracks (Internal / Motion)

Figure 57 Removed Track Site Diagram. Dotted line represents remaining mainline track(s).

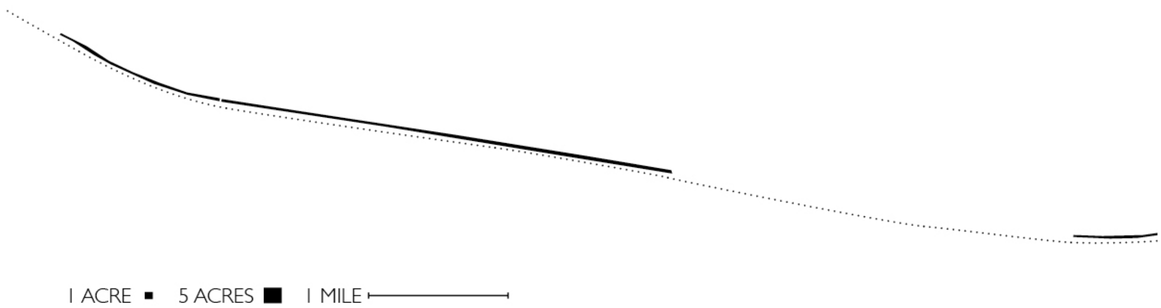


Figure 58 Removed Track Site Condition. Dotted line represents remaining mainline track(s).

In locations where a track has been removed from the mainline, a thin site often exists. While in many places these sites are occupied for necessary maintenance to the mainline, in locations where the right of way is slightly wider—either due to topography or surrounding land use—these sites are vacant. The extended length of the sites allows an individual riding on a passenger train to engage with these sites. Although the sites are spatially intermittent, looking at them experientially might provide a better approach toward any landscape intervention: a train passenger would experience these sites as a sequence.

2) Rail Yard Parcels (Internal / Motion)

Figure 59 Rail Yard Parcels Site Diagram. Dotted line represents remaining mainline track(s).

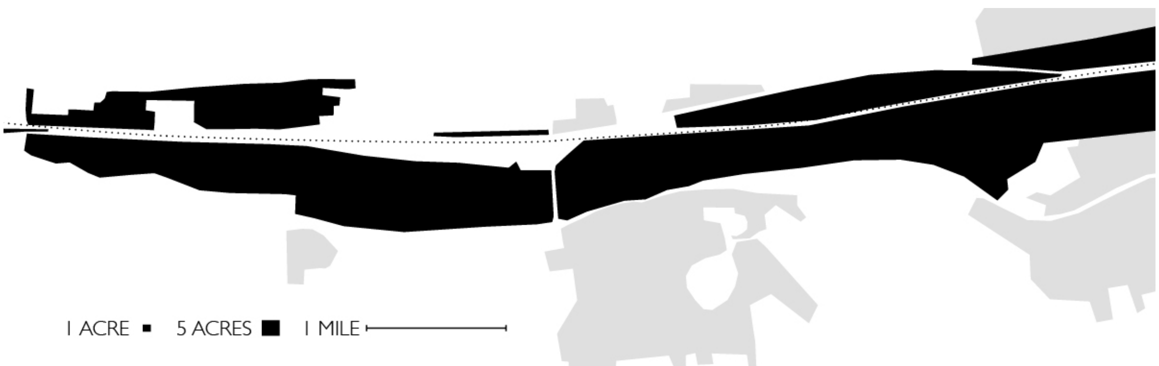


Figure 60 Rail Yard Parcels Site Condition. Black sites indicate rail yard parcels; grey sites indicate adjacent parcels and are shown for context. Dotted line represents remaining mainline track(s).

As abandoned and underutilized rail yards present the largest cluster of sites along the Norfolk Southern Railway's Eastern Division, they offer one of the most promising areas for landscape interventions. Passenger trains typically slow down while moving through rail yards, giving passengers a prolonged experience of these sites. Further, since there are often large parcels of land that are unused, these sites have a depth that could accommodate a wider variety of program than could, for example, a linear site where a track of the mainline was removed.

3) Sinews (Internal / Motion)

Figure 61 Sinew Site Diagram. Dotted line represents remaining mainline track(s).

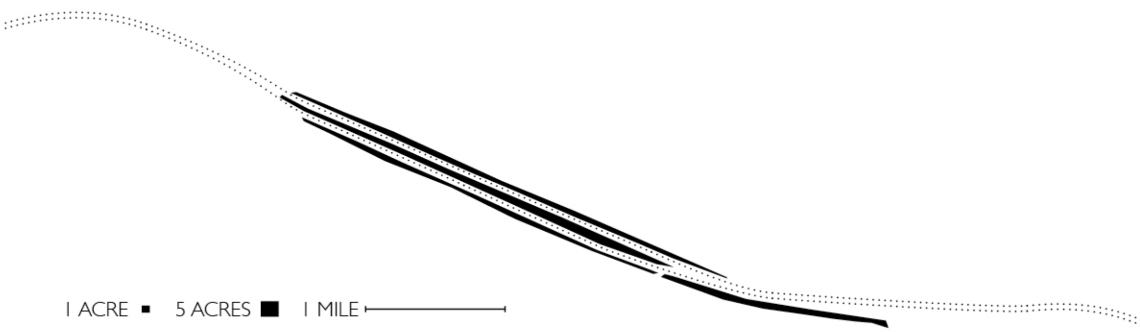


Figure 62 Sinew Site Condition. Dotted line represents remaining mainline track(s).

Sinews immerse passengers on trains within a collection of sites. Although the sites are thin, their length adds to this immersion; the fact that they often surround the tracks adds to this immersion. Frequently the sites that compose a sinew are continuous. Where these sites are created from now-outdated railroad infrastructure, the sites tend to be in remote places with public access only available, visually, via train; where these sites are created from thin strips of unused railroad yard, they tend to be enveloped within an urban context.

4) Adjacent Parcels (Internal / Motion)

Figure 63 Adjacent Parcels Site Diagram. Dotted line represents remaining mainline track(s).

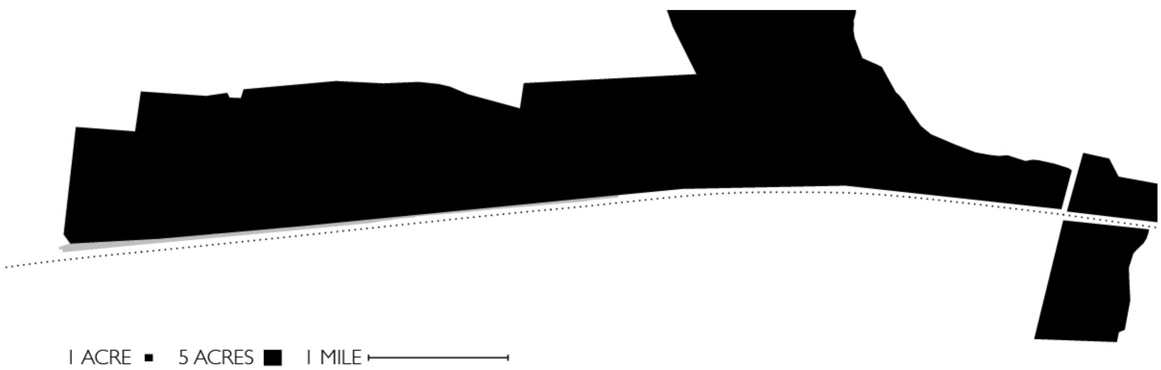


Figure 64 Adjacent Parcels Site Condition. Black sites indicate extractive or post-industrial parcels adjacent to right of way; grey site indicates a site where a siding has been removed. Dotted line represents remaining mainline track(s).

Both post-industrial and extractive (or post-extractive) sites adjacent to the Norfolk Southern are often visible to train passengers. The visibility of these sites speaks to the history of the corridor and the surrounding landscape: railroads often were catalytic to adjacent development, a pattern that remains persistent even as technology and transportation methods have changed. Although many of these sites are only the scale of a single industrial building and thus offer only a briefly passing node to a passenger, many sites are extensive and provide a prolonged opportunity for visibility.

5) Crossing Rail Yards (External / Motion)

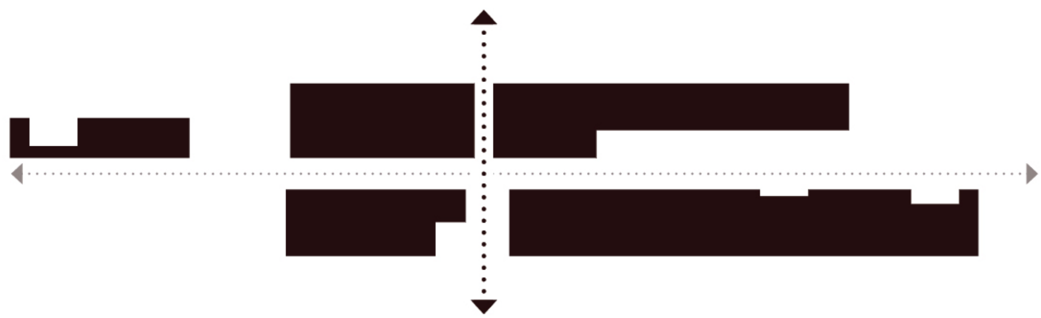


Figure 65 Road Crossing Rail Yard Site Diagram. Greyed-out dotted line represents remaining mainline track(s). Vertical line indicates perpendicular vehicular traffic.

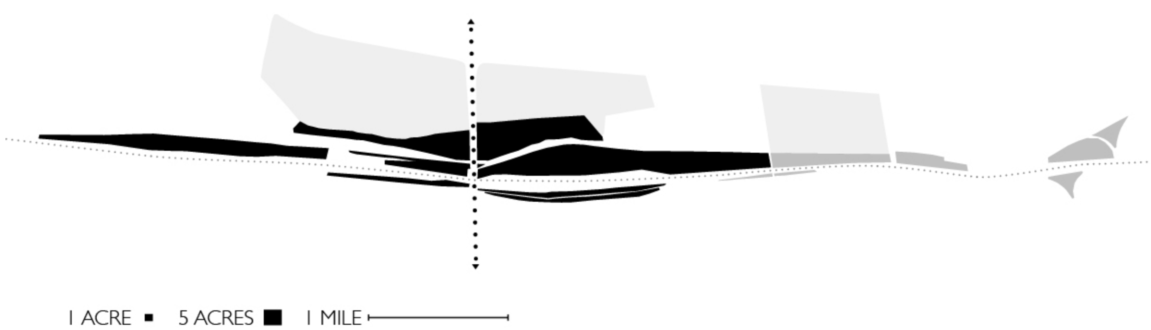


Figure 66 Road Crossing Rail Yard Site Condition. Black sites depict rail yard; grey sites included for context. Greyed-out dotted line represents remaining mainline track(s). Vertical line indicates perpendicular vehicular traffic.

Roads crossing rail yards are typically elevated on an overpass, offering a panoramic view across what is today largely unused land. In many cases rail yards divide populated areas of town, since the town developed around the rail route and then rail yard, and many rail yard crossings carry significant volumes of traffic. The elevated perspective offers a passing driver (or, in some cases, a pedestrian or a cyclist) extended views down the axis of the rail yard; because rail yards are typically level, the view is unobstructed.

6) Rail Yard Core (External / Stationary)

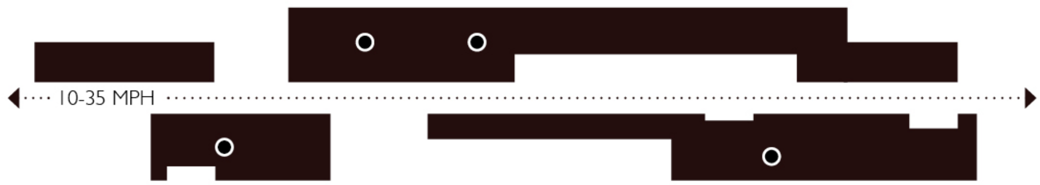


Figure 67 Rail Yard Core Site Diagram. Dotted line represents remaining mainline track(s). White circles indicate potential locations of occupation.

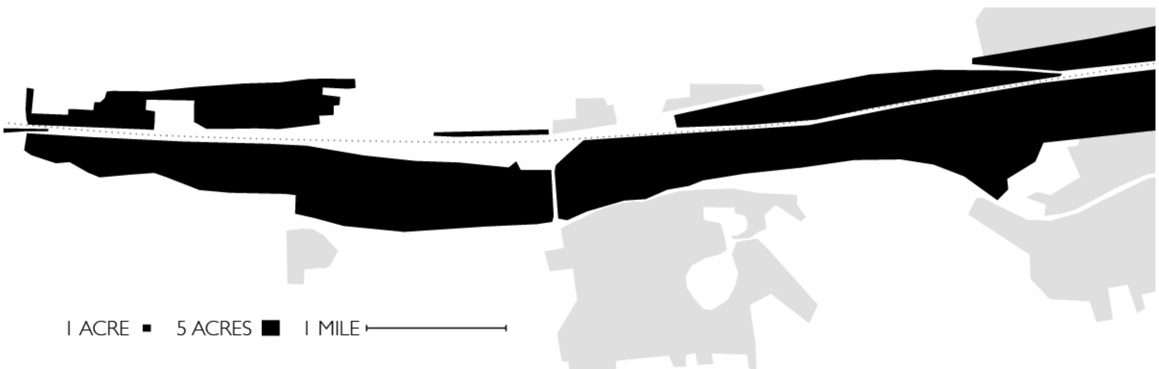


Figure 68 Rail Yard Core Site Condition. Dotted line represents remaining mainline track(s).

As developed areas typically surround rail yards, where rail yards have been abandoned there is often a core of land that is unused. This pattern repeats at a variety of scales, from large rail yards that span entire towns to now-abandoned sidings that slice the urban fabric of a village. Regardless of the scale, these sites create a contiguous (or nearly contiguous) core of land. The extent, location, and current vacancy of these collections of sites create the opportunity for a significant landscape intervention that is aimed toward improving the landscape available to nearby residents.

7) Post-industrial Threshold (External / Stationary)

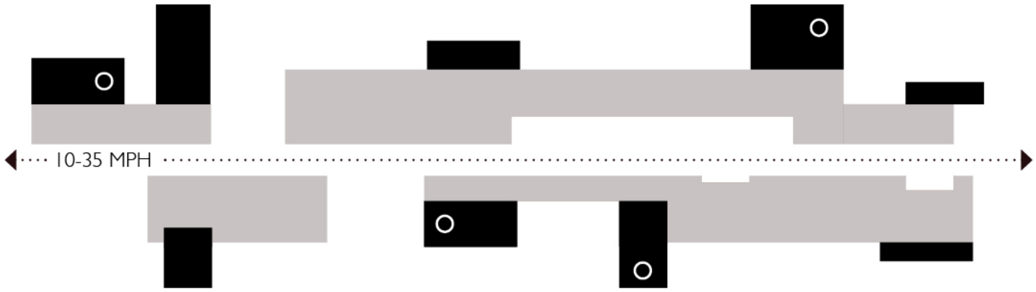


Figure 69 Rail Yard Threshold Site Diagram. Dotted line represents remaining mainline track(s). White circles indicate potential locations of occupation.

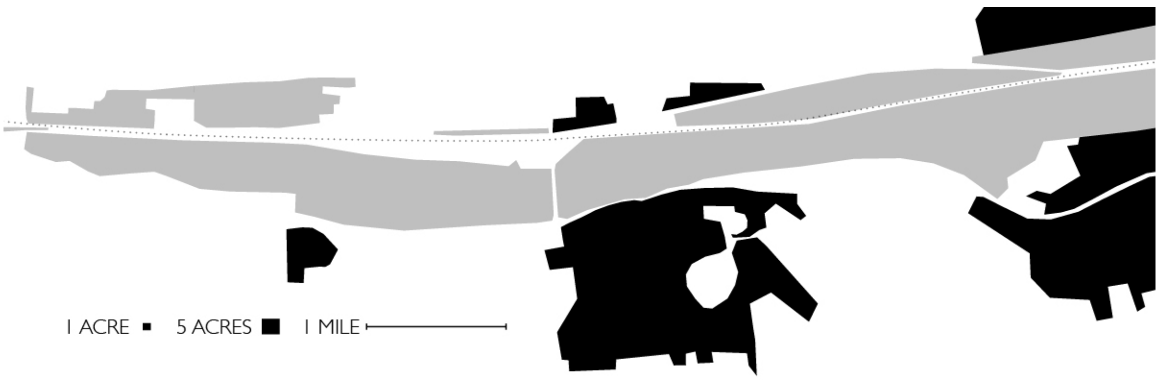


Figure 70 Rail Yard Threshold Site Condition. Black sites depict parcels adjacent to corridor; grey sites depict corridor parcels and are shown for reference. Dotted line represents remaining mainline track(s).

While an abandoned rail yard can be seen as a core of sites that is surrounded by a developed area, a cluster of post-industrial sites that were originally developed to take advantage of the railroad surrounds the core area. These sites buffer the surrounding town or neighborhood from the rail yard, though they also physically separate the surrounding residents from the core of the yard. In another way, the post-industrial sites can be seen as a threshold to the core sites that are within the rail yard. These threshold sites offer a direct point of contact with surrounding residents. This creates a hierarchy of sites—with periphery sites having the potential to be actively inhabited by residents and core sites, with more technical and safety restrictions, holding a different program.

Site and Corridor Experience: Susquehanna-Roseland Electric Transmission Line

1) Linear Site (Internal / Motion)

Figure 71 Linear Site Diagram. Dotted line indications potential movement along the corridor.

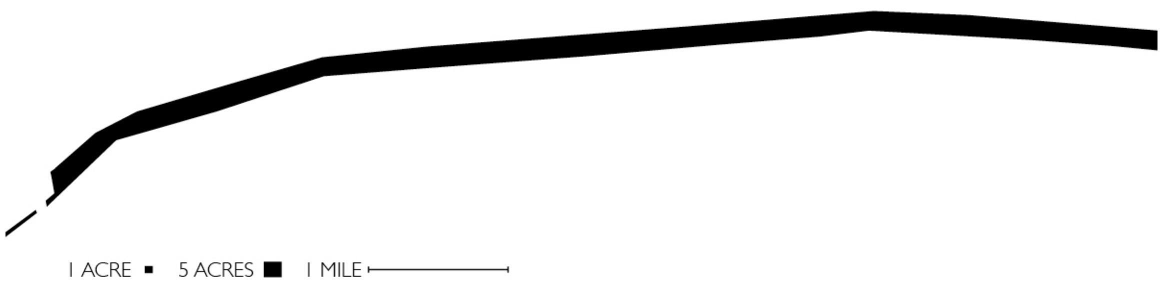


Figure 72 Linear Site Condition.

The linear quality of much of the Susquehanna-Roseland electric transmission line lends itself to movement along its axis. While vehicle access is not compatible with the requirements of the corridor, access and movement by people, plants, and animals could occur. In this fashion, the corridor functions as either a) a large, linear disturbance, where the vegetation is artificially maintained in a shrubby or grassy state; b) a long edge condition that slices adjacent land uses. While the ecologically negative edge effects of cutting a corridor are undeniable, the management of the corridor's vegetation and its linear nature potentially offer a site to ameliorate some of these negative effects.

2) Knots (Internal / Stationary)

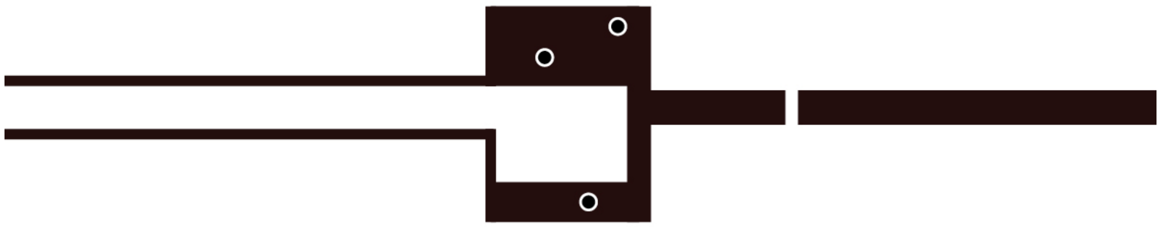


Figure 73 Knot Site Diagram. White circles indicate potential locations of occupation.

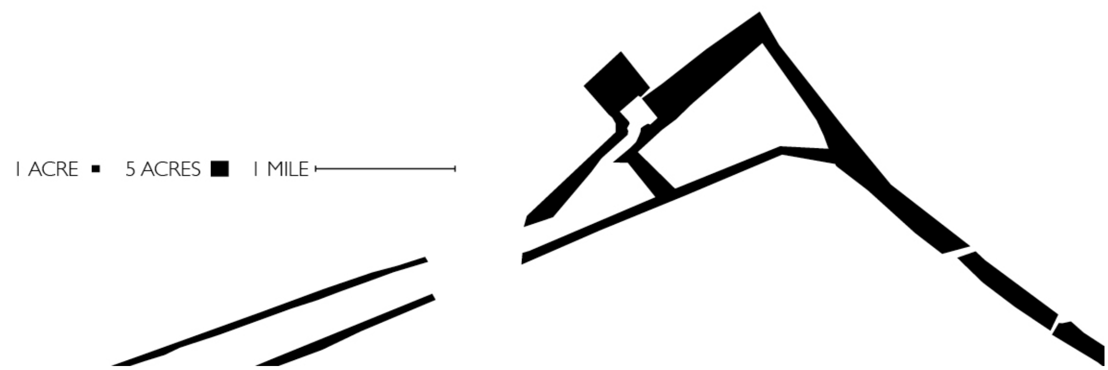


Figure 74 Knot Site Condition.

As knots often occur at topographically challenging locations (e.g., steep hillsides) or at substations, access to these areas is sometimes limited. However, by concentrating a variety of linear conditions within a small area, these complicated knots present an opportunity for the complexity of the corridor to be experienced.

3) Road Crossings (External / Motion)

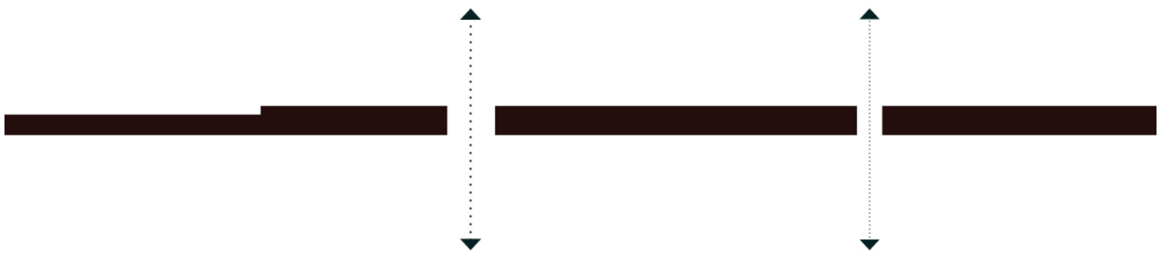


Figure 75 Crossing Site Diagram. Vertical dotted lines indicate perpendicular vehicular traffic.

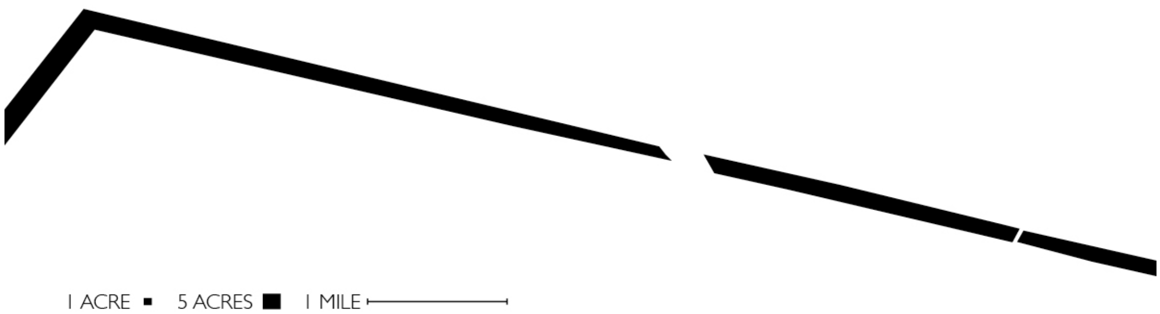


Figure 76 Crossing Site Condition

As Susquehanna-Roseland typically avoids densely settled areas—except where crossing a settled valley is unavoidable—the corridor's landscape often remains unseen by residents. However, where roads intersect with the corridor perpendicularly, there is an intense reveal of the linear character of the corridor; driving along a road, especially through a forested area, the moment of crossing the corridor results in a rapid reduction of enclosure. These are intense moments of experience. Leveraging these sites has the potential to embed the corridor within the consciousness of the surrounding residents. Therefore, any program that occupies these sites can forge an identity, positive or negative, of the corridor.

4) Post-extraction (External / Stationary)

Figure 77 Post-extraction Site Diagram. White circles indication potential locations of occupation.

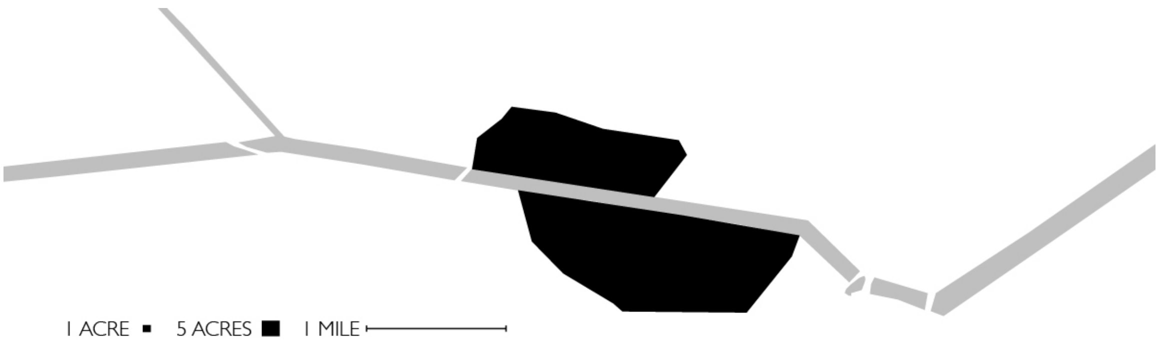


Figure 78 Post-extraction Site Condition.

As Susquehanna-Roseland rarely reacts to the surrounding landscape, many of its crossings with post-extraction areas, such as quarries and anthracite coal spoil piles, are incidental. However, as the corridor has the potential to provide linear access to and through these lands, the corridor itself becomes a method of binding together otherwise disparate or inaccessible sites. Thus, with these sites the corridor functions as a linear, connective site in relation to the extractive site.

[1] Pushkarev, “The Esthetics of Freeway Design”; Tunnard and Pushkarev, *Man-Made America*.

[2] Appleyard, Lynch, and Myer, *The View from the Road*.

[3] Halprin, *Freeways*.

[4] Ibid., 12.

[5] For a more thorough examination of motion in landscape design, see Michel Conan, ed., *Landscape Design and the Experience of Motion* (Washington, D.C.: Dumbarton Oaks Research Library and Collection, 2003). See also John Dixon Hunt, “Moving Along in the Automobile,” in *The Afterlife of Gardens* (London: Reaktion Books, 2004), 173–90.

Chapter Six:
Situation: Sites to System, Corridor to Region

Beyond the spatial and experiential aspects of the sites that compose infrastructure corridors, an additional factor of value to my research is that the sites exist alongside an existing, active corridor of conveyance and in contact at certain points with the surrounding region. In other words, the sites are bound together by sources of movement with the potential to reduce the burden of distance.[1] This point is important because it presents the opportunity for the sites along each corridor to be considered not only individually or by contiguous collections but by association with all other sites along the corridor, even if the sites are separated by significant distance. Distance within these corridors and within the region becomes less of a meaningful separation between sites. Sites can then be conceptualized as existing within flows of goods, materials, and people to form systems.

This idea builds on the work of Pierre Bélanger that has focused on concepts of regionalization and the design of flows between distant infrastructural elements and processes.[2] Much of Bélanger's work has focused on corrective measures in landscape—e.g., remediating brownfields or shifting materials from where they are considered a nuisance to where they are valued. Regardless, Bélanger's focus on viewing regional patterns as complicated industrial-ecological processes—in that they present a system that contains flows, actions, responses, and disturbances—helps to frame the specific examples proposed in this chapter. Clare Lyster has also written about the collision of systems and sites, noting that these collisions (or mergers) often form locations for unexpected landscape interventions.[3] Drawing from this literature and terminology, each site that composes the landscape of an infrastructure corridor can be seen as a location of a collision between a specific parcel of land and the conveyance of the corridor; certain sites can be seen as collisions between site and region. This suspends these sites somewhere between the local and the regional or even national scale.[4] Movement along the corridor and movement into the surrounding region cause the sites to be liminal.

This chapter, however, diverges slightly from the above-mentioned research by focusing less on the concepts that might support specific programs and interventions and more on the spatial conditions that the three case study corridors offer. As opposed to the previous two chapters that have discussed each corridor individually, the analysis in this chapter will instead focus on certain spatial conditions that lead to systems, which might exist across more than one of the case study corridors. The focus in this chapter is on both Interstate 80 and the Norfolk Southern Railway, as these corridors have an accessible method of conveyance within the corridor. Because Susquehanna-Roseland conveys electricity and not materials, its relationship with systems has a different character, which limits the possibilities for landscape interventions connected to conveyance.

Connecting Two Corridor Sites

The most obvious and common system connection in the researched corridors is the linking of two sites. This pattern, present both on Interstate 80 and the Norfolk Southern Railway, is simply the connection of two non-contiguous sites through the use of the corridor. For Interstate 80, automobiles or trucks make the connection between sites; for the Norfolk Southern Railway, trains or individual freight rail cars make the connection between sites. Regardless of how the sites are connected, the main point is that two sites with different conditions and potential programs are linked together through the corridor, increasing the area and variables leveraged in any landscape intervention. Interventions can then be conceptualized as occurring on the combination of the two sites. The result of connecting sites allows for a more space-intensive intervention than would be possible on a smaller site or allows for the separation of distinct phases or sequences for an intervention.

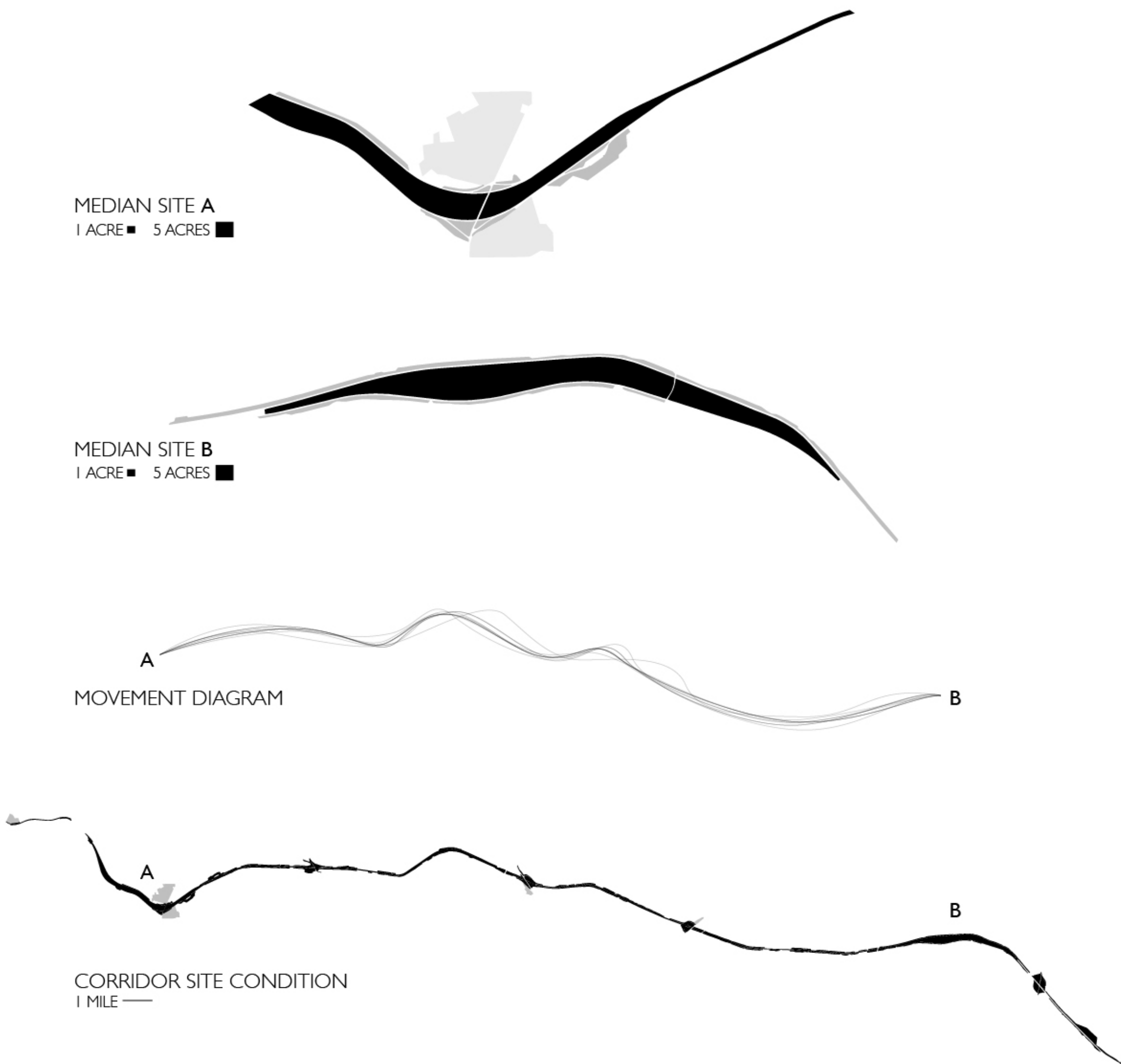


Figure 79 Interstate 80 Two Connected Sites. Note: scale varies between portions of the diagram, as indicated.

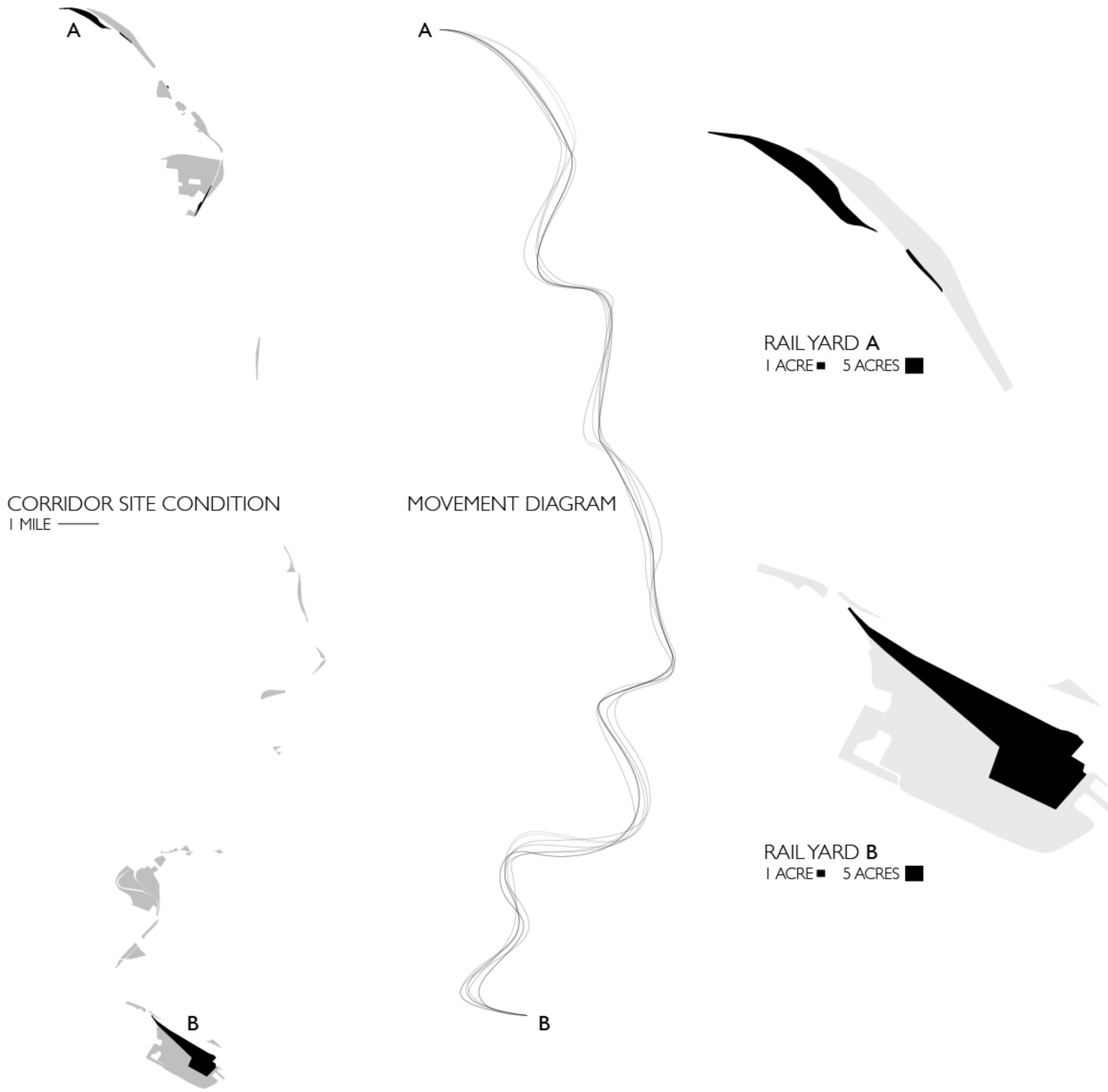


Figure 80 Norfolk Southern Railway Eastern Division, Two Connected Sites. Note: scale varies between portions of the diagram, as indicated.

Connecting Multiple Corridor Sites

Building on the previous category, there exists the potential to connect multiple sites along a corridor. The arrangement of these sites could be multiple sites connected as a daisy chain, multiple sites linked together in a changing pattern, or multiple sites with a rigid hierarchy, where sites lower in the hierarchy are used to supply, inform, or support the program of sites higher in the hierarchy. Regardless of the pattern, through conveyance the area available for an intervention is increased dramatically by utilizing an already existing method of conveyance.

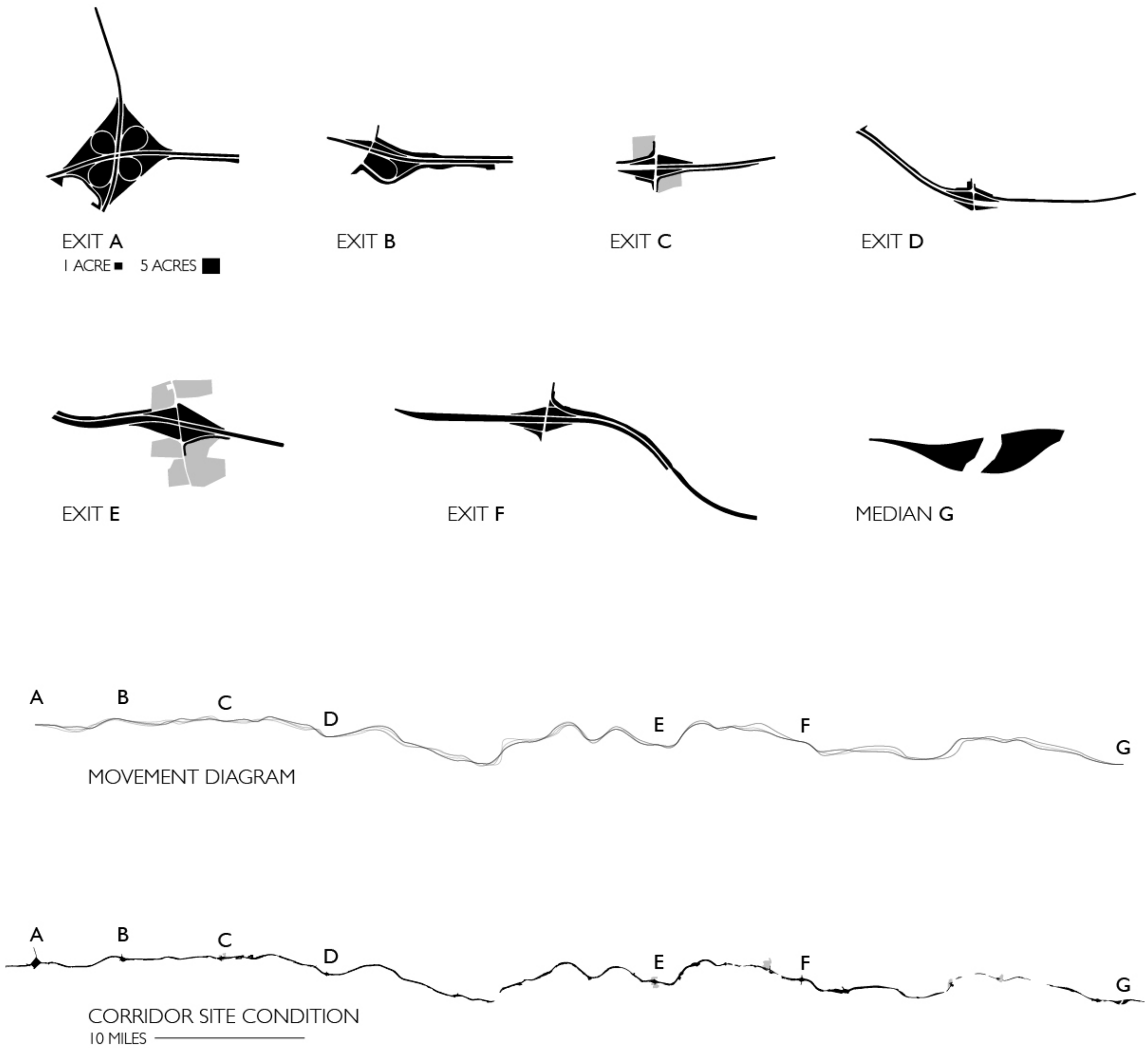


Figure 81 Interstate 80 Multiple Connected Sites. Note: scale varies between portions of the diagram, as indicated.

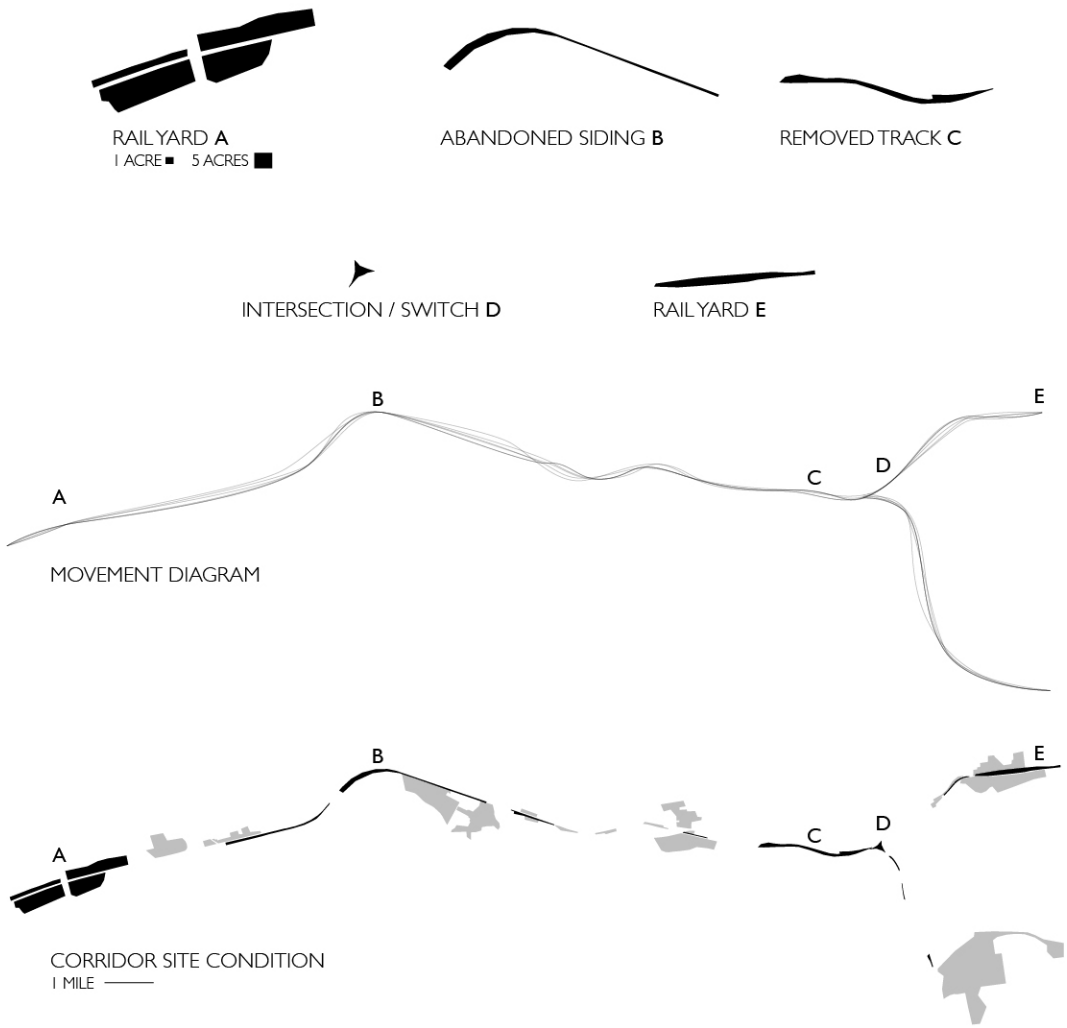


Figure 82 Norfolk Southern Railway Eastern Division Multiple Connected Sites. Note: scale varies between portions of the diagram, as indicated.

Connecting Adjacent Sites to Corridor

Sites adjacent to the corridors can also be linked using the ease of movement offered by the corridor. This approach leverages the surrounding landscape that a corridor crosses toward any landscape intervention. Thus, there is a response in the intervention to the surrounding landscape.[5] This idea also reverses notions of a corridor being inherently negative to the ecological and social health of a region, as this provides an alternative vision of an existing corridor as a potential ameliorative measure. As an example, a corridor could be leveraged to help repair a larger pattern of ecological devastation, such as unreclaimed and abandoned strip mines. Each type of corridor responds differently to this idea and offers different advantages. In all, movement along the corridor acts to concentrate activity from dispersed sites.

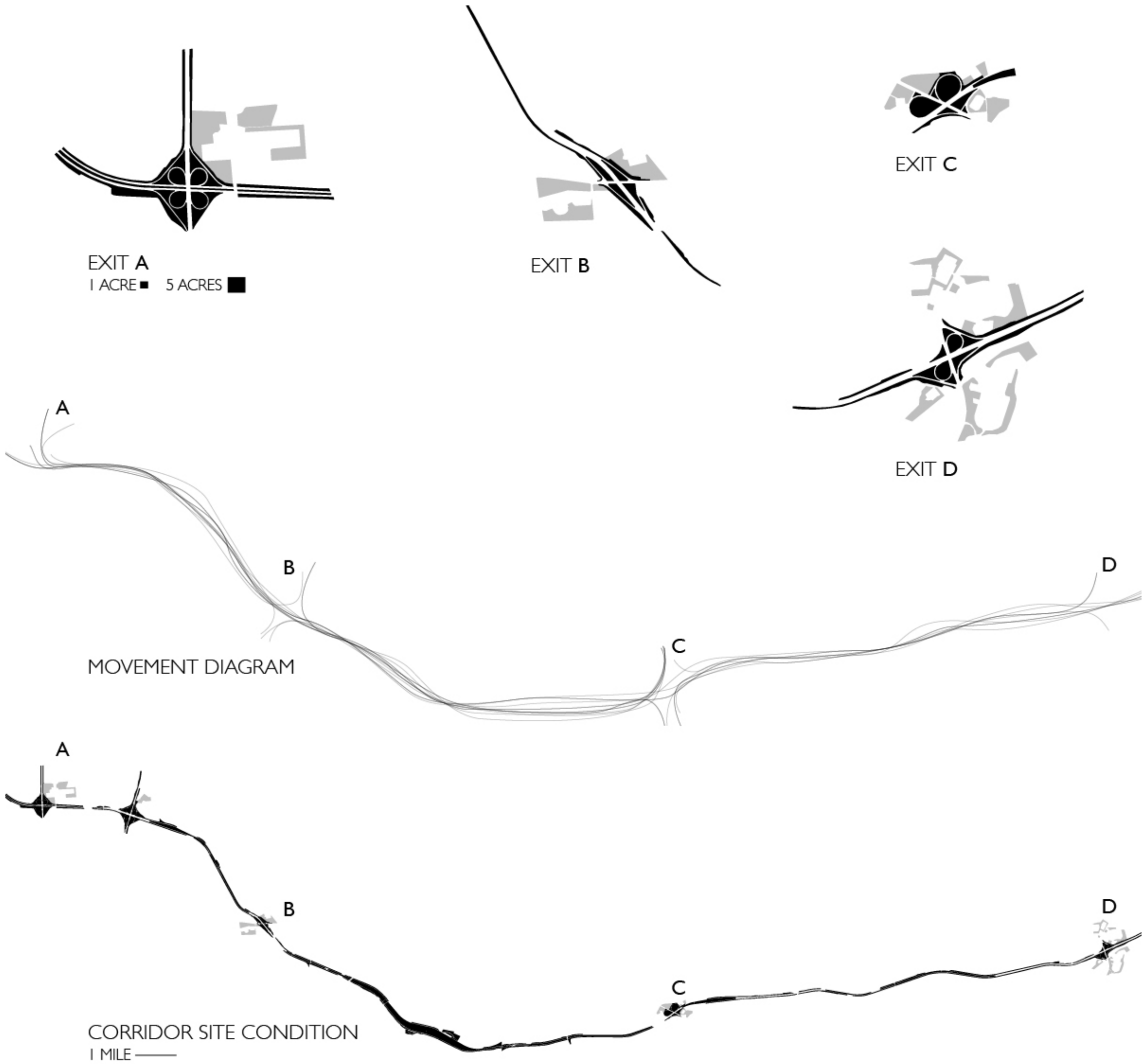


Figure 83 Interstate 80 Connected Adjacent Sites. Note: scale varies between portions of the diagram, as indicated.

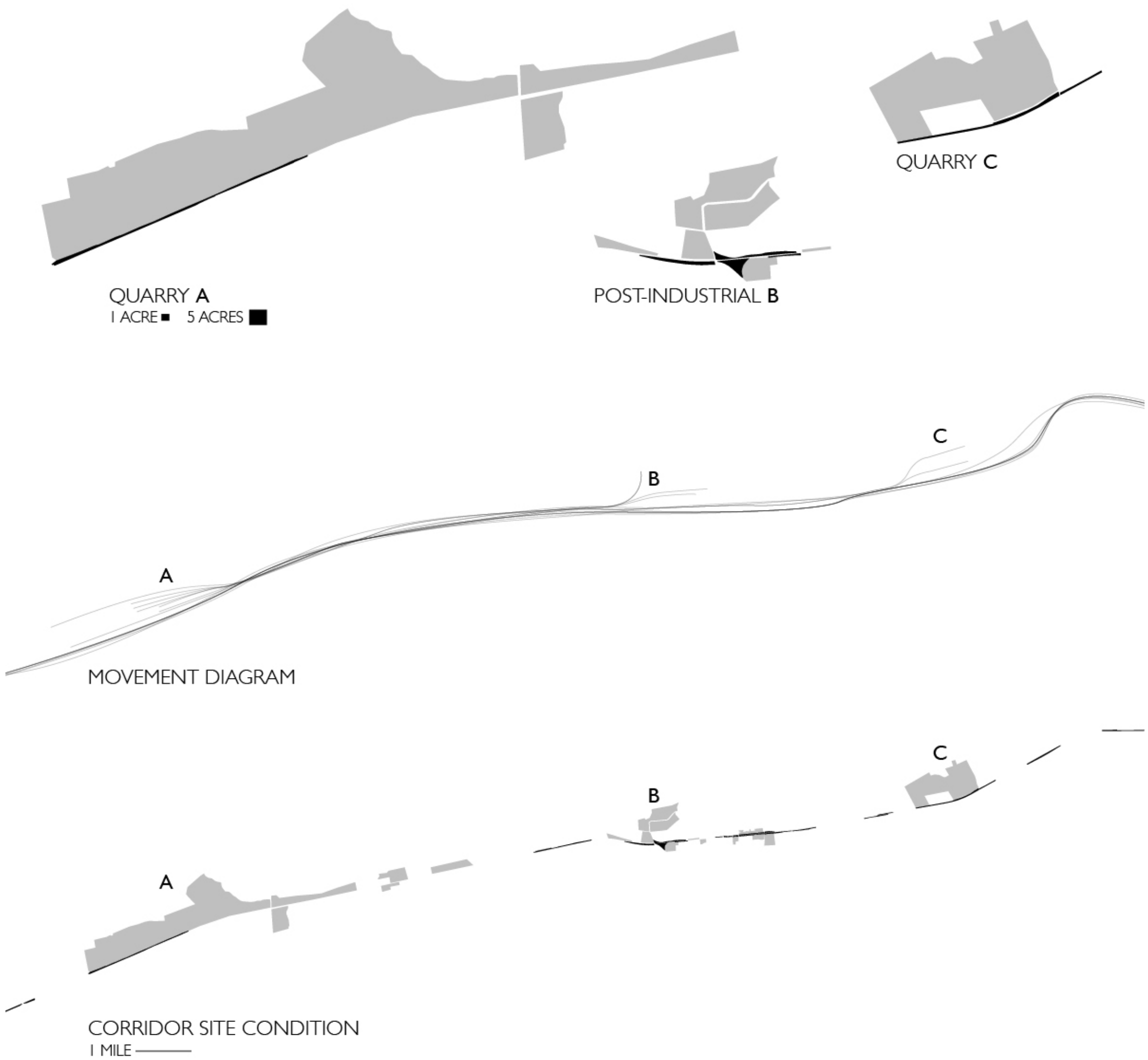


Figure 84 Norfolk Southern Railway Eastern Division Connected Adjacent Sites. Note: scale varies between portions of the diagram, as indicated.

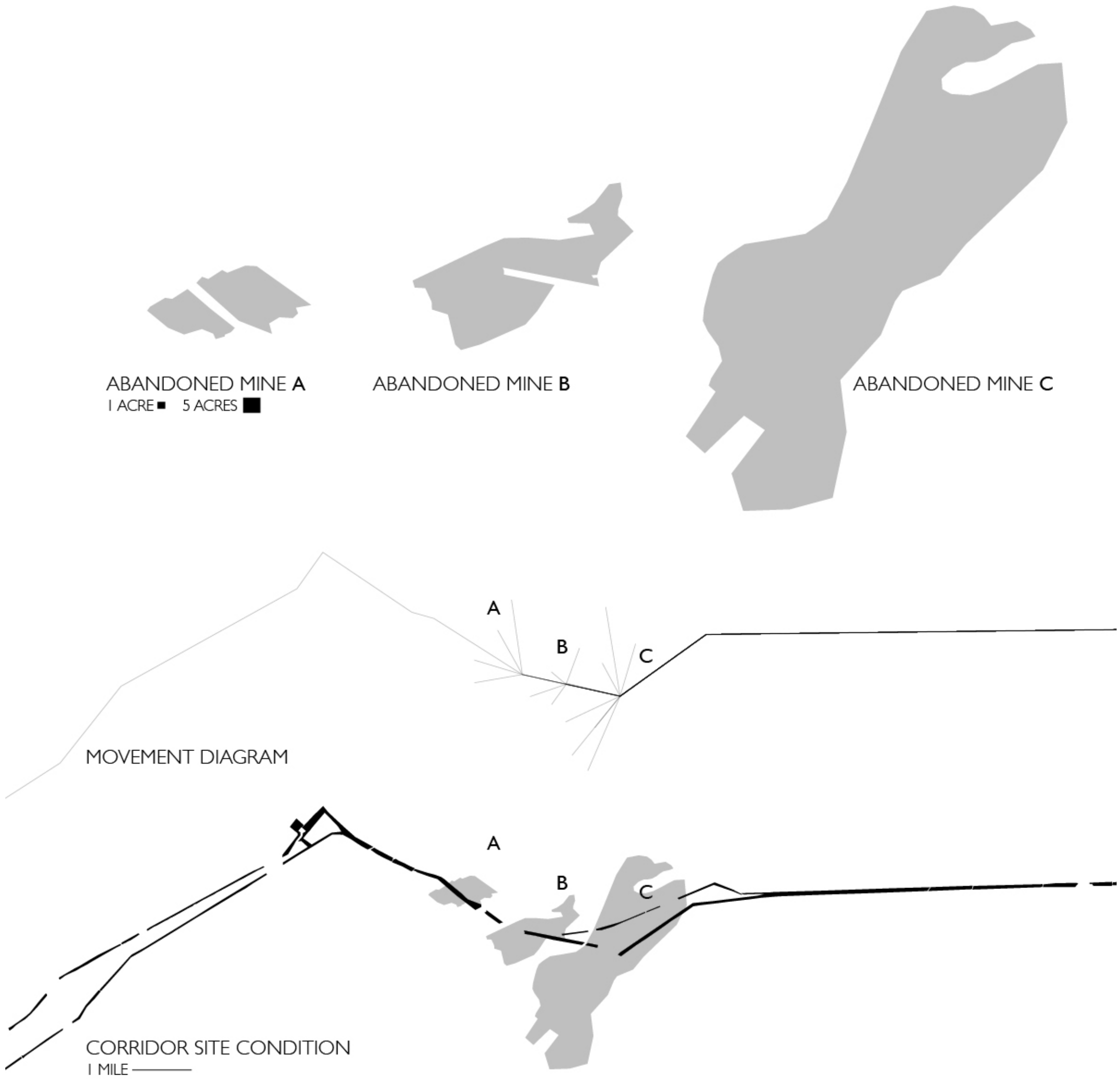


Figure 85 Susquehanna-Roseland Electric Transmission Line Connected Adjacent Sites. Note: scale varies between portions of the diagram, as indicated.

Corridor as Collector

Looking beyond the sites that exist either within the corridors or the sites that are adjacent to the corridors, it is important to consider the surrounding landscape. If each corridor can be seen as a means of conveyance or a linear path that could potentially allow conveyance and sites along each corridor can be seen as potential places for the storage, transformation, or distribution of materials—there exists the opportunity to connect these two attributes with the surrounding landscape. In this scenario, the corridor is leveraged as a means of connecting the wider landscape to the sites within a corridor, repositioning select sites as locations of occupation. Each corridor has points where this larger, regional system can interchange with the corridor. For Interstate 80, these points are exits or interchanges. For the Norfolk Southern Railway, these points are sidings, rail yards, or intermodal facilities. For Susquehanna-Roseland, these points are areas of potential generation or areas of potential consumption.

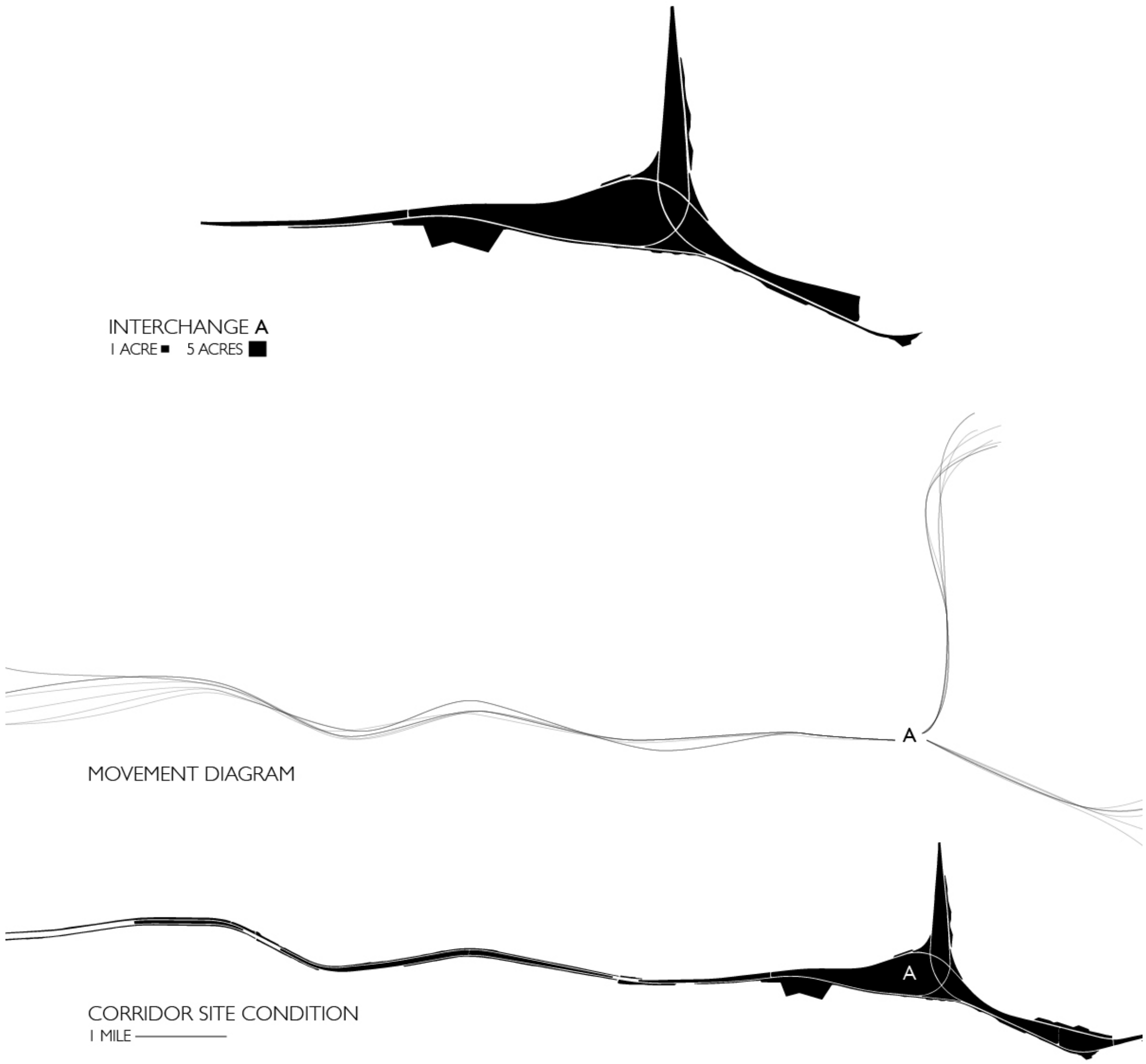


Figure 86 Interstate 80 Corridor As Collector. Note: scale varies between portions of the diagram, as indicated.

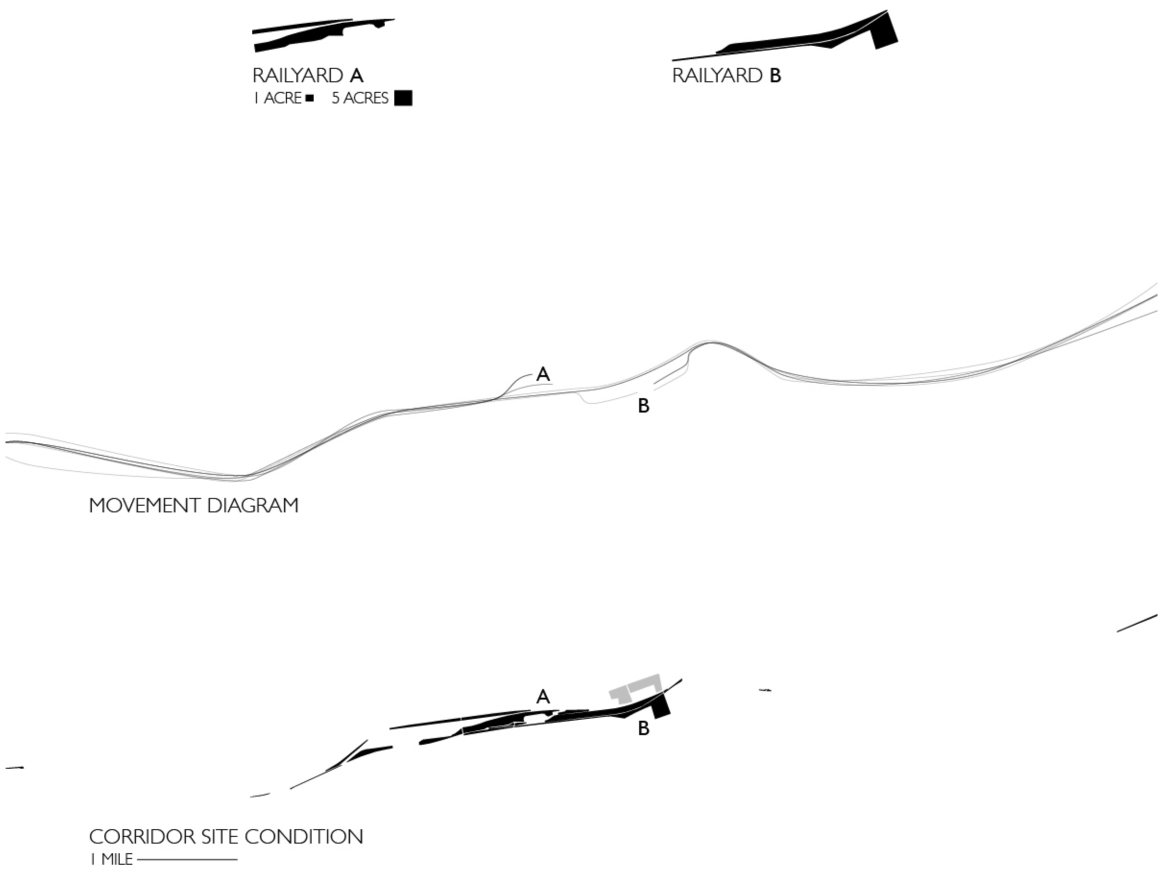


Figure 87 Norfolk Southern Railway As Collector. Note: scale varies between portions of the diagram, as indicated.

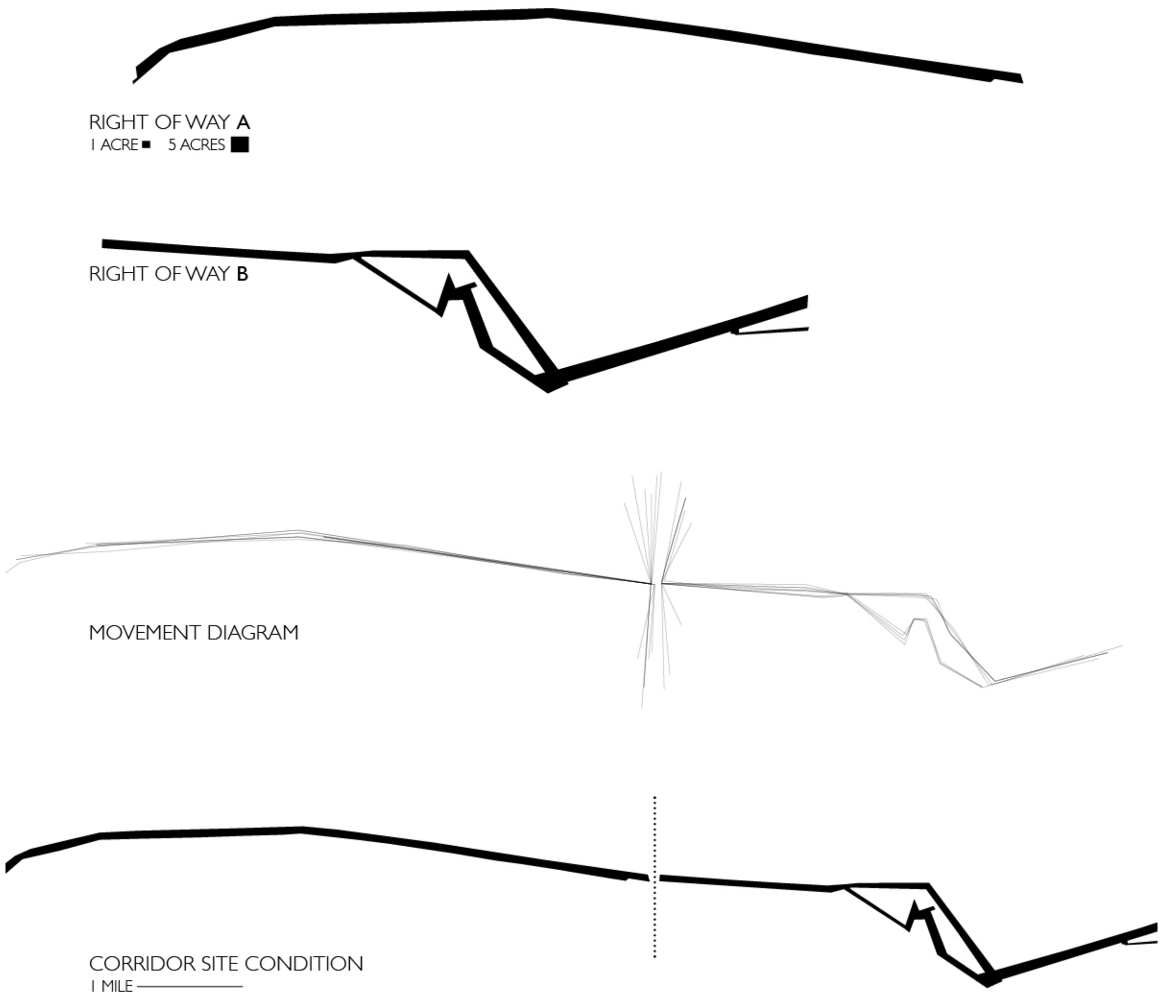


Figure 88 Susquehanna-Roseland As Collector. Note: scale varies between portions of the diagram, as indicated. Dotted line indicates a road crossing, where vehicles might access corridor and then move along existing maintenance roads.

[1] For further discussion of the relationship between shrinking experiential distance and improvements in the speed and range of transportation technology, see Lyster, "Landscapes of Exchange: Re-Articulating Site," 221–222.

[2] Bélanger, "Landscape as Infrastructure"; Bélanger, "Redefining Infrastructure"; Bélanger, "Landscape Infrastructure: Urbanism Beyond Engineering"; Pierre Bélanger, "Landscape Infrastructure," *Harvard Design Magazine*, no. 36 (2013): 154–57.

[3] Lyster, "Landscapes of Exchange: Re-Articulating Site."

[4] As early as 1960, Boris Pushkarev argued for interstate highways to be seen as an important element when conceptualizing urban regions. See Pushkarev, "The Esthetics of Freeway Design."

[5] Concern about the influence of infrastructure corridors on the surrounding landscape has, of course, been a concern of landscape architects and social critics since the early days of the interstate highway system. See, for example, Scott, "Case History of a Super Highway."

Chapter Seven:
Expanding The Landscapes of Infrastructure Corridors

Observations From Case Studies

Using the methods proposed in Chapter 3, developing and then analyzing diagrams for Interstate 80, the Norfolk Southern Railway Eastern Division, and Susquehanna-Roseland led to a refined level of insight into the landscapes of the selected infrastructure corridors. The spatial structure was elevated to the foreground, allowing the sites along infrastructure corridors and the arrangement of sites to be studied. The most obvious result of these case studies was to reveal details about the specific corridors—e.g., where certain sites are located and in response to what specific factors. Chapters 4 through 6 established these details. However, the case studies and the analysis in Chapters 4 through 6 are also valuable by providing specific landscapes through which more universal aspects of the spatial structure of infrastructure corridor landscapes were revealed. Although the case studies all exist within specific cultural, ecologic, and technologic contexts, a number of observations made through studying these corridors can be applied more broadly. These observations are listed below, often with the specific example or examples that sparked that observation during the case studies. These observations do not provide an exhaustive list of the factors that form the landscapes of infrastructure.[1] Instead, these observations are meant to agitate or to provoke existing conceptions of these landscapes toward the goal of establishing a new concept for the landscapes of infrastructure corridors. A new concept for the landscapes of infrastructure corridors is proposed in the following section.

Variability in Corridor Sites

Instead of an unchanging line, infrastructure corridors present a surprising amount of variability in sites, both within the corridor and adjacent. Site scale, site location, and site arrangement vary frequently; corridor width and structure often modulate in response to various external factors (which are discussed below). Landscapes of infrastructure corridors can be seen as heterogeneous spaces, not as homogenous lines, regardless of how they are often experienced or perceived. This observation allows for corridors to be seen as a sequence of sites, not only as a vector of motion, challenging the idea of a corridor as a line. The method of conveyance, however, remains the overall organizational structure of the corridor; it is important to remember that the sites that exist along an infrastructure corridor only exist because of the engineered method of conveyance. Sites, then, must be seen as corollary to the method of conveyance; sites are typically structured around this method of conveyance.

Given the overall linearity of infrastructure corridors, many of the sites found along the corridors are long with limited width. However, there are other types of sites that tend to occupy a less linear area of space, and these sites are found more frequently along infrastructure corridors than expected. In the research conducted here, Interstate 80 and the Norfolk Southern Railway Eastern Division—i.e., transportation corridors—provided the greatest variety of sites. Susquehanna-Roseland, however, also offered site opportunities beyond the linear, especially at nodes along the corridor. Examples of the variability of these sites can most easily be seen in this study by browsing Appendices D, E, and F, which present the mapped sites of all three corridors in a gridded catalog.

Corridor Links Sites

While the above mentioned sites can be treated as single, independent entities—with each site having definite boundaries—these sites also have the potential to be treated as an interconnected whole. With the presence of a method of conveyance on the corridor, sites can be linked together. (This is especially true of transportation corridors but can also be applied to corridors that transmit energy, as the route of a transmission line or pipeline offers a potential route for movement.) With this perspective, two or more sites can be merged together in a single landscape intervention, with the method of conveyance as a connecter. On Interstate 80, for example, this connector is some variety of automobile or truck; on the Norfolk Southern, this connector is either a train or a railroad car. Given this connection, materials can be moved between sites. This idea blurs scale, as sites themselves become scalable entities. Corridors also have the potential to provide links between adjacent sites and corridor sites, and the surrounding landscape and corridor sites. Thus, this perspective on infrastructure corridor sites begins to refute accepted distinctions between site and region. A site has the potential to become regional; a region has the potential to be concentrated in a site or a series of sites.

A further observation deserves note: While corridors are typically though of as linear—i.e., as connecting two points—it is also possible to think of corridors in a non-linear sense. With this view, there exists a potential to view the linking of sites along a corridor in a non-linear fashion, allowing for an indeterminate reshuffling of sites (and of the scale of sites) in response to any proposed landscape intervention.

Heterogeneous Topography as a Generator of Site(s)

Toward the above point regarding the variability of sites along infrastructure corridors, heterogeneous topography is often a generator of different sites along a corridor. Topography directly influences the type, scale, and position of the sites that compose infrastructure corridors; areas of greater topographic heterogeneity tend to have larger numbers of and larger sizes of sites along the corridor. For example, a corridor moving across a level ground plain would require minimal manipulation of the ground plane for direct passage. This allows the corridor to be efficient, with minimal excess space. However, the more heterogeneous the ground plane, the more manipulation is required, resulting in less efficiency. This observation is most relevant to transportation corridors, since these corridors have strict requirements of grade for the travel surface and frequently require on-off access at grade—both resulting in a greater manipulation of the ground plane in response to topography.

Site generation from topography can occur at different scales. For an example of a large scale topographic problem creating a single site, the Allegheny Front along Interstate 80 (see Appendix A) required the land to be significantly modified to allow the interstate to cross this topographic divide within the required grade limit. The result of this engineering problem is that the east and west lanes of the interstate split apart, with each occupying a side of a shallow stream valley. (The stream has been channeled, removed, or buried where it conflicts with the interstate.) From this solution, a site of significant size is located between the travel lanes. For an example of a smaller scale topographic problem creating a sequence of sites, the approach to the Allegheny Front along Interstate 80 also required significant cutting an filling, resulting in a series of manipulations of the terrain. At each location where this occurred, a site of varying size was created along the highway. These sites stretch along Interstate 80, creating a series of sites along the corridor.

Geologic and Physiographic Context as a Classifier of Sites

More specific than simply being aware that topography generates sites along infrastructure corridors, the geologic and physiographic context of a corridor provides a frame to classify the sites along that corridor. In other words, the geologic and physiographic context of a corridor—and especially as that context changes along the length of a corridor—creates different categories of sites, changing site scale, location, and arrangement. The spatial language of a corridor changes depending on the geologic or physiographic context. For example, sites along the Norfolk Southern Railway Eastern Division within a broad, relatively level limestone valley have a different pattern than when the corridor is chipped into the mountainous fringe of a river valley. As another example, sites along Interstate 80 have one pattern when the highway crosses the Appalachian Plateau and another pattern when the highway crosses through a series of ridges in Ridge and Valley. The same concept applies to adjacent sites: geologic and physiographic context alters the types and scales of adjacent sites. This is most obviously noted in this study with bituminous coal mining along Interstate 80 and with anthracite coal mining along Susquehanna-Roseland. There are, however, also consistencies within each corridor, even if the geologic and physiographic context changes along the corridor's length. Along Interstate 80, exits and rest area sites exist in any wider context, just as rail yards exist along the Norfolk Southern in any wider context. These common types of sites do often respond to the context, taking a situational yet identifiable form. Hinting at a major opportunity in the design of the landscapes of infrastructure corridors, these sites hybridize the typological with the specific.[2]

Spatial Landscape Histories

The history of the landscape surrounding an infrastructure corridor and the history of the landscape containing an infrastructure corridor are sometimes revealed through the spatial structure of the corridor—i.e., the spatial structure of the corridor is not a completely an externally imposed, engineered condition but rather interacts with the history of the landscape it crosses.[3] Although this observation is obvious, as nearly any landscape reveals its history through a palimpsest of spaces, this observation offers two valuable approaches to corridors. First, this observation foregrounds the notion of infrastructure corridors developing and changing through time. This awareness—essentially that the landscapes of infrastructure corridors are a large-scale process acting on and with the surrounding landscape—offers a potential method to both analyze and design existing infrastructure corridors.[4] Second, this observation allows the landscapes of infrastructure corridors to be read as containing multiple simultaneous spatial narratives. With this view, an infrastructure corridor permits allowance for both the engineered form of the corridor and the vernacular form of the surrounding landscape. This allows infrastructure corridors to be perceived and represented beyond "high-modernism,"[5] shifting toward a more complex vision of how the corridor interacts with the landscape.

Adjacent Sites as Response to Corridor and Context

Although adjacent sites are discussed above as being classified by geologic or physiographic categories, adjacent sites often respond to both wider context and the corridor in more subtle ways. Most importantly, corridors are catalytic toward the surrounding landscape, initiating either intentional or unintentional changes;[6] these changes often create adjacent sites that could be leveraged into any potential landscape intervention. In a way, these adjacent sites can be seen as part of the corridor, as their formation was closely tied to the development and function of the corridor. Adjacent sites can be seen as part of the historic spatial process that an infrastructure corridor generates. The creation of these sites, however, is not abstract. These sites are created at a point of mediation between the influence of the corridor and the surrounding context. In areas adjacent to corridors, factors such as land use, land ownership, and economy alter the scale and persistence of a corridor's influence. Adjacent sites, then, are a point of conflict or agreement between the function and requirements of the corridor and the function and requirements of the surrounding landscape. This contentious situation has created brightly lit commercial plazas within rural agricultural areas along Interstate 80 and has created rail yards within residential neighborhoods along the Norfolk Southern Railway Eastern Division. However, as a point of mediation, these sites must also be seen as important areas of contact between the corridor and the surrounding landscape.

Multiple Experiences of Site

A site along an infrastructure corridor should be not be seen as interacting with only users of a corridor, with only stationary individuals outside of a corridor, or only individuals moving outside of a corridor. Rather, any site along a corridor should be seen as having the potential to accommodate a spectrum of experiences. In other words, a single site holds many various potentials for experience. Sites along infrastructure corridors can then be seen as containing many conflicting moments of experience. This idea is linked to the fact that most sites along infrastructure corridors, both within the corridor and adjacent, exist in locations that are visible by multiple types of users.

Corridor and Context as Armature

An infrastructure corridor and the corridor's immediate geographic context provide a spatial and experiential armature for any proposed landscape intervention.[7] In other words, the corridor and its surroundings provide a structure that can be leveraged toward any design that is implemented. The importance of this point is to recognize that the construction of a corridor is a significant and visible mark on the land; this mark's scale provides a source of spatial organization, by which any proposed landscape intervention can be aligned.[8] Spatially, this armature creates a general organization within the sequence of sites along the corridor; experientially, this armature creates both a common vector of experiencing the landscape while moving or a common source of movement when viewing the corridor from a distance.

Collision(s)

If infrastructure corridors can be seen as a collection of sites, then there are certain focal points along each corridor that are points of contact between the corridor and some variety of external force—e.g., movement, space, or topography. These can be seen as places of collision.[9] Where a corridor collides with an external force, often both the corridor and that external forced are modified, generating a spatial aberration that creates sites along the corridor. Such focal points include locations such as where a secondary road crosses a corridor, an at-grade crossing, where a corridor crosses a mountain or river, or at an exit ramp. A second category of collisions exists where a method of conveyance from the surrounding landscape interacts and transitions to an infrastructure corridor. Examples of these sites include freight depots, intermodal facilities, exits, transfer stations, and power plants. Beyond the sites that are created through these collisions, these collisions represent the potential to initiate contact (or conflict) between corridor and context, between region and corridor, between site and context, between site and corridor, between site and region. These collisions are dynamic places that are situated within the flows both internal and external to the corridor. These collisions function simultaneously on both the site and regional scale. Building on the idea of multiple experiences that is mentioned above, these points of collision also represent sites where there is the potential for a collection of experiences in a single space. Abandoned bituminous strip mines along Interstate 80 present a strong argument for this perspective. These large sites have the potential to be occupied by local residents, to be occupied by transient users of the corridor, to be viewed from the corridor, and to be viewed from the surrounding landscape. Any landscape intervention proposed on these sites exists within this situation.

Proposed Concept for the Landscapes of Infrastructure Corridors

The result of these observations—and the conclusion of the research presented in this thesis—is a more refined and more complex conception of the landscapes of infrastructure corridors. The research presented in the preceding chapters informs this new concept, and from my research it is possible to trace an evolution of the conceptions of landscapes of infrastructure corridors. Building on the most common perception, in my research infrastructure corridors were initially conceptualized as a line that connects two points, with minimal spatial variability in between. Corridor as line was seen as a monofunctional, engineered object. Through the mapping of the case studies, however, it was realized that infrastructure corridors offer a significant diversity and number of sites along their length.[10] Sites of various sizes and configurations exist within corridors and adjacent to corridors. This sparked the realization that infrastructure corridors are not only a line; they are a line that is surrounded by a collection of sites. The recognition of these sites shifts an infrastructure corridor from a place of movement to a place of potential occupation. In this view, infrastructure corridors become a sequence of landscapes. This observation allows for new approaches to the design of landscapes of existing infrastructure corridor. The simple realization that infrastructure corridors are heterogeneous landscapes and not lines creates new potential fields for landscape architects to design.

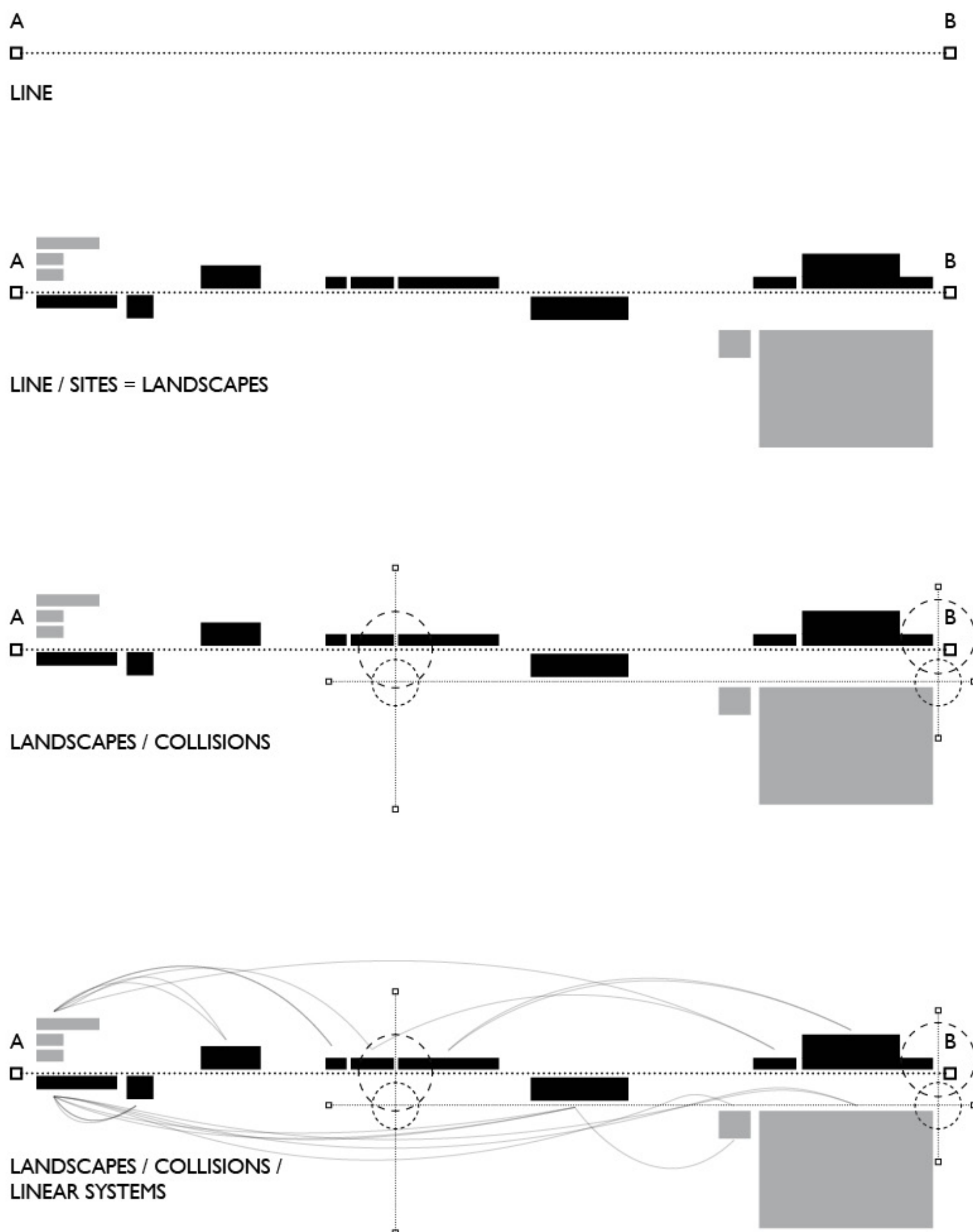


Figure 89 Sequence of Infrastructure Corridor Concepts.

It was realized through further analysis of the case studies, however, that the landscapes of infrastructure corridors do not exist in isolation. There are collisions, as mentioned in the preceding section, between external forces and the landscapes of the corridor. These collisions create focal points within a corridor, where flows, and materials, and experiences overlap and accumulate. At these points of collision, corridors and sites begin to interact with more distant sites and even regions. These forces concentrate attributes of the region at the collisions with the corridor. Landscapes of infrastructure, therefore, exist within and influence a wider context, even beyond the boundaries of the corridor. Infrastructure corridors are not distinct entities; they are both landscapes and processes. Beyond these collisions that occur from external forces, the landscapes of infrastructure corridors also present an established method (or potential path) for conveyance. This allows the landscapes of infrastructure corridors to be seen as a linear system, with the capability for geographically distant sites within the corridor to be connected through the method of conveyance. This linear system interacts most vividly with the collisions from the wider landscape at points of contact between the two—e.g., in a rail yard or an interstate exit. Thus, the linear system of an infrastructure corridor has the potential to influence a much larger territory, blurring the boundaries of sites along the corridor and even the corridor itself. The landscapes of infrastructure corridors exist in a liminal state between site, motion, and region.[11] In this liminal state, there is the context of a site or of a collection of sites but there is also the suspension of distance that results from a functioning method of conveyance. Landscapes of infrastructure corridors, then, exist both in the specifics of certain sites and the more abstract and much larger scale of the region. These landscapes present both material specifics and the potential to change significantly through regional processes. The idea that the landscapes of infrastructure corridors operate beyond the traditional boundaries of the corridor—and could be leveraged beyond the boundaries with any proposed landscape intervention—ultimately leads to what my research proposes as a refined and more useful concept: the landscapes of infrastructure corridors as an indeterminate aggregation of sites.[12]

It is valuable to further define the importance of both 'indeterminate' and 'aggregation,' and how each term is used in this concept. Aggregation is used to represent infrastructure corridors not as a linear sequence of sites—say, from east to west—but as a selection of sites—drawn from corridor sites, adjacent sites, and regional sites or processes—brought together through the method of conveyance within the corridor. Linear becomes collage.[13] The method of conveyance becomes a backbone, an organizational structure that offers cohesion to a larger system. This collection of sites allows a landscape architect to take a more expansive view of designing the landscapes of an infrastructure corridor, drawing from sites created through the imposition of an engineered object through a landscape and from sites created by the geologic and physiographic context of the surrounding landscape.[14] The corridor becomes a means of activating a collection of otherwise unrelated and unconnected sites; the method of conveyance obliterates spatial restrictions, facilitating this flexibility. A singular terrain develops between the surrounding landscape, the sites, and the corridor: topology.[15] Indeterminate is used to indicate the value and potential of an unpredictable flux of both physical space and change over time within the landscapes of an infrastructure corridor.[16] In the expanded field of the landscapes of infrastructure corridors, there are nearly endless sites that could potentially be leveraged into a landscape intervention; all of these sites exist within the potential influence of the corridor.[17] This situation creates a plethora of different sites—each with a different site-specific context—that can be leveraged through the corridor.[18] This scale of influences can change, depending on the type of corridor, on economic and ecologic conditions, and on available funding. Indeterminacy, while accommodating this change in scale, also indicates that change over time is unpredictable. Sites will change. Economic demands will change. Ecologic consciousness and law will change. Climate will change. And viewing infrastructure corridors as an indeterminate aggregation of sites over time allows landscapes architects to design flexible, resilient interventions.[19] The overall value of the landscapes of infrastructure corridors being seen as an indeterminate aggregation of sites is to present landscape architects with the possibility of programming a system of sites that leverages the movement of a corridor.[20]

This concept aligns with the continued shift of the profession from the construction of form to the propagation of processes.[21] An indeterminate aggregation of sites allows for a flux in scale and scope, placing a landscape architect in the position to design, at the same time and the same place, both site and process, site and flow, and site and region.[22] Conditions can be propagated on sites in response to local conditions, while remaining within a wider framework, both of corridor and region.[23] Context is vital.[24] Further, because these arrangements are meant to change over time, any intervention has the potential to be dispersed and flexible, changing in response to external factors over decades.[25] Interventions, of some variety, could be scale-able, taking cues and methods from agriculture;[26] actively cultivated interventions on a site can develop models that can be applied to other sites. Sites can be catalytic to other sites.[27] Depending on local and regional needs, sites can be mothballed or increased in size or leveraged with other sites with conflicting or complimentary conditions and situations.[28] Ultimately, this is the most valuable prospect of this new concept: providing landscape architects with the potential to work on locally informed sites that are leveraged along the corridor on a regional scale. This approach co-opts the high modernist form of infrastructure corridors and injects, on a site level with material, ecological, and historical specificity, the local knowledge and responsiveness[29]—which James C. Scott has called mētis[30]—that will allow any proposed intervention to be beneficial, relevant, and sustainable to the communities surrounding the infrastructure corridor.

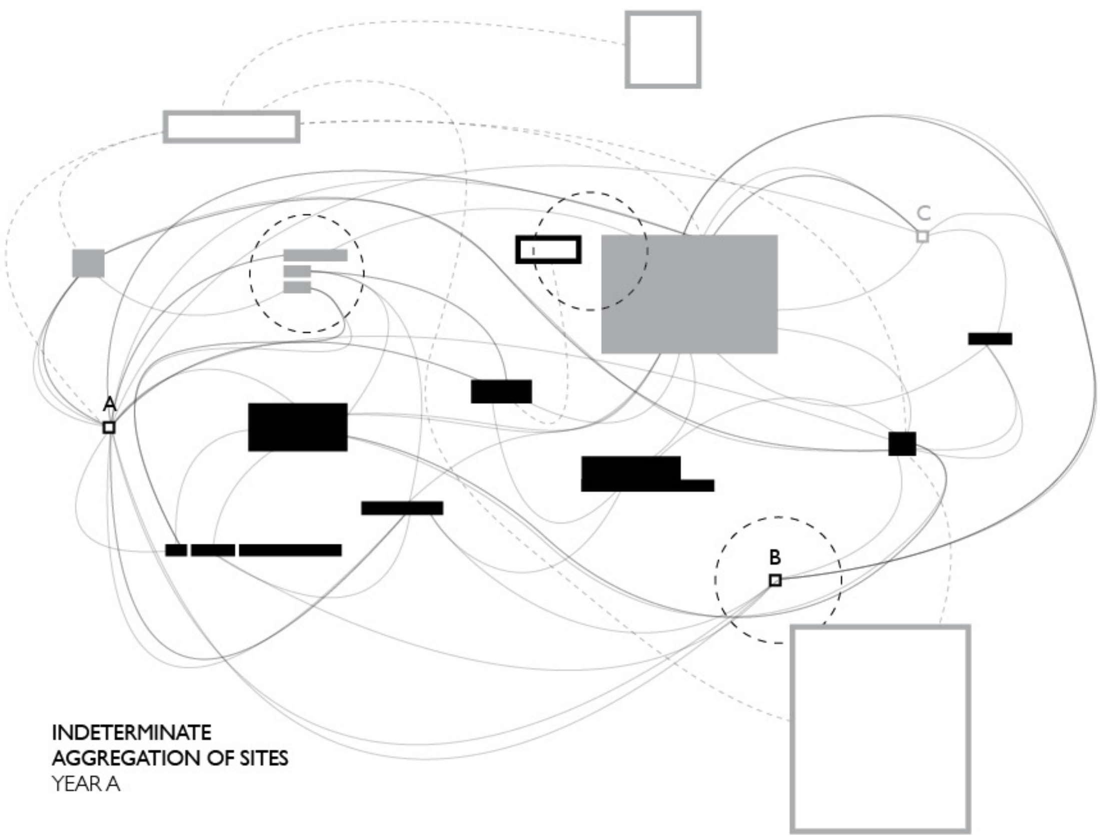


Figure 90 Indeterminate Aggregation of Sites Diagram, Year A.

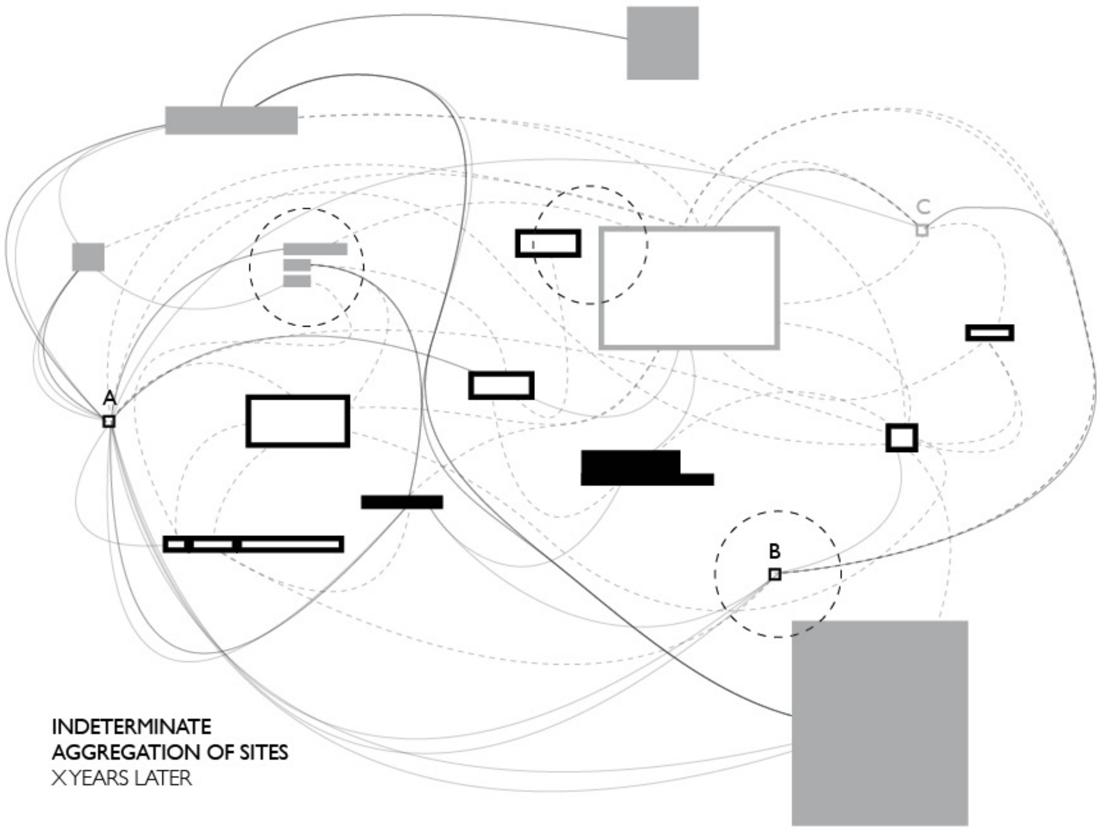


Figure 91 Indeterminate Aggregation of Sites Diagram, X Years Later.

[1] In noting a list of observations followed by a new conception of infrastructure corridors, I am relying on Karl Kullman's approach to the analysis of linear parks. See "Thin Parks / Thick Edges."

[2] For various discussions of hybrids in infrastructure, see Hood, "Landscape as Social Infrastructure: Hybrid Modifications—Scraping, Weaving, Stratifying, and Lumping"; Delbene, "Hybridize! Rules of Engagement of Landscape and Infrastructure"; Angélil and Klingmann, "Hybrid Morphologies"; Strang, "Infrastructure as Landscape"; Poole, "Civitas Oecologie." Elissa Rosenberg also argues for the use of hybrids, both in design and in facilitating a breakdown of traditional divides between natural and built form. See "Public Works and Public Space."

[3] This observation relies on an expansive definition of history as applied to landscape. For a thorough and revealing analysis of how various types of history influence the design of landscapes, see John Dixon Hunt, *Historical Ground: The Role of History in Contemporary Landscape Architecture* (London ; New York: Routledge, 2014). See also Degree 5 in Poole, "Potentials for Landscape as Infrastructure, Part I: Six-and-a-Half Degrees of Infrastructure." Van Acker also uses landscape history to convey the spatial conditions of infrastructure in Acker, "Re-tracing the Ringscape—Infrastructure as a Mode of Urban Design."

[4] For an example of a study that attempts to reveal the spatial structure of an infrastructure corridor through time, see Qviström, "Network Ruins and Green Structure Development."

[5] Scott, *Seeing like a State*.

[6] For another, more specific case study that bolsters this argument, see the discussion of the Mississippi River Parkway in Johnson, "Preserving the Scenic Qualities of the Roadside."

[7] See Morris and Browns argument that infrastructure systems hold the potential to be seen "as armatures for culture." Morrish and Brown, "Putting Place Back into Infrastructure," 52.

[8] See Halprin's discussion of the "form-giving" potential of interstate highways. Halprin, *Freeways*, 5.

[9] Lyster, "Landscapes of Exchange: Re-Articulating Site." For an earlier example of discussing the influence of a corridor on the surrounding landscape, see Scott, "Case History of a Super Highway."

[10] Also see Pushkarev's argument on the importance of the spaces along interstate highways, "The Esthetics of Freeway Design." Qviström also discusses a transition of a corridor from a line to an area in "Network Ruins and Green Structure Development."

[11] Motion in this sentence is used to two distinct ways: as Halprin argued, as choreography of user experience (see Halprin, *Freeways*, 12.); materially, as in the movement of materials from distant locations to sites along the corridor.

[12] Aggregate is also used in reference to infrastructure and leveraging multiple sites across large scales by Ying-Yu Hung in Hung, "Landscape Infrastructure: Systems of Contingency, Flexibility, and Adaptability." The term is also implied by Matos in Sousa Matos, "Urban Landscape."

[13] Colin Rowe and Fred Koetter, *Collage City* (Cambridge, Mass.: MIT Press, 1978).

[14] See the discussion of highways and the English landscape in Sylvia. Crowe, *The Landscape of Roads* (London: Architectural Press, 1960).

[15] See Angélil and Klingmann, "Hybrid Morphologies"; Christophe Girot, "About Topology: An Integrated Comprehension of Landscape," *Topos: European Landscape Magazine* 82 (2013): 24.

[16] See Alan Berger, Dirk Sijmons, and Wouter Mikmak Foundation, *Systemic Design Can Change The World; Utopia's Practical Cousin* (Amsterdam; Baarn: SUN; Wouter Mikmak Foundation, 2009); Scott, *Seeing like a State*; Corner, "Terra Fluxus"; Allen, *Points + Lines*; Koolhaas, "What Ever Happened to Urbanism?"; Angélil and Klingmann, "Hybrid Morphologies"; Bélanger, "Landscape Infrastructure: Urbanism Beyond Engineering." For a less directly related discussion—though one that seems to have influenced the texts mentioned in this foot note—see David Harvey, *The Condition of Postmodernity: An Enquiry Into the Origins of Cultural Change* (Oxford [England]; Cambridge, Mass., USA: Blackwell, 1990).

[17] Strang's 1996 argument for the holistic design of large-scale infrastructural landscapes remains valid (and, regrettably, infrequently cited in recent infrastructure literature within landscape architecture). See Strang, "Infrastructure as Landscape."

[18] G.A. Jellicoe made a similar point in the mid-twentieth century, though his discussion is more visually focused. See Jellicoe, "MOTORWAYS."

[19] See Bélanger's discussion of artificial ecologies in "Landscape as Infrastructure."

[20] See discussion of road ecology and network theory in Forman et al., *Road Ecology*, 298.

[21] This concept also works within the theories of landscape architecture that propose that the same landscape intervention can accommodate both form making and the initiation of indeterminate processes. See Corner, *Recovering Landscape*; James Corner and Alison Bick Hirsch, *The Landscape Imagination: Collected Essays of James Corner, 1990-2010* (New York: Princeton Architectural Press, 2014); Poole, "Potentials for Landscape as Infrastructure, Part I: Six-and-a-Half Degrees of Infrastructure"; Sawyer, "Territorial Infrastructure."

[22] See Shannon and Smet's argument for the "territorial dimension of infrastructure" in Shannon and Smets, "Towards Integrating Infrastructure and Landscape," 64. For discussion of landscape flows, see Bélanger, "Redefining Infrastructure."

[23] See Pollak's discussion of multi-scale interventions in Pollak, "Landscape for Urban Reclamation."

[24] See discussion of infrastructure context in Eberhard and Bernstein, "A Conceptual Framework for Thinking about Urban Infrastructure."

[25] Hung, "Landscape Infrastructure: Systems of Contingency, Flexibility, and Adaptability"; Berger, Sijmons, and Wouter Mikmak Foundation, *Systemic Design Can Change The World; Utopia's Practical Cousin*; Parolotto, "Reversible Infrastructure."

[26] See Strang's mention of an agricultural ethos in the design of the landscapes of infrastructural systems in "Infrastructure as Landscape."

[27] Poole, "Potentials for Landscape as Infrastructure, Part I: Six-and-a-Half Degrees of Infrastructure," 32.

[28] See Hung's discussion of infrastructure phasing in Hung, "Landscape Infrastructure: Systems of Contingency, Flexibility, and Adaptability."

[29] See Morris and Brown's discussion of how infrastructure systems have potential to interact with natural systems. Brown and Morrish, "Toward a New Infrastructure." Also see Strang, "Infrastructure as Landscape"; Forman, *Land Mosaics*; van Bohemen, "Infrastructure, Ecology and Art"; Shannon and Smets, "Towards Integrating Infrastructure and Landscape." For a related discussion, see Paul's application of Frampton's concept of critical regionalism to infrastructure in Paul, "From Object Line to Vector Field—The Social Instrument."

[30] Scott, *Seeing like a State*, passim.

Chapter Eight:
Future Research Directions

The research presented above offers several starting points for future research:

Program Studies

The most natural direction for future research to build is to address precisely what types of programs are appropriate to deploy across the landscapes of infrastructure corridors. This could involve one of two approaches: 1) the design of specific sites in specific locations at specific times; 2) the design of patterns and processes that have the potential to be deployed across an entire corridor.

Continental Scale

Another potential route is to apply a similar method and concept as proposed in my research to the length of an entire corridor—e.g., Interstate 80 across North America. The value in this scale of study would be to reveal a deeper level of understanding in how a corridor (as an engineered condition) interacts with the context of the surrounding landscape. Although the scale of this study could be prohibitive, mapping and documenting a selection of, say, the 300 most promising sites along Interstate 80 could be a feasible approach.

Sites and Vectors of Corridor Influence

The research presented in this thesis began to think about corridors as beyond a distinct spatial entity. In this view, corridors have the potential to be influential across a region. Where this influence extends and along what vectors this influence extends could be valuable studies. Further, what economic, geologic, or physiographic factors expand or limit this influence?

Defining Adjacency

In this study, in order to have a better understanding of the context of the corridor, adjacent sites were mapped along with corridor sites. Adjacency was limited to geography. However, given that the conclusion of my research suggests an expanded idea of adjacency that is based less on geographic distance, how far from a corridor can a site be and still be considered adjacent? This question is related to the idea of influence presented above.

Examine a Region, Not a Corridor

While this study deliberately approaches the landscapes of infrastructure corridors through study of specific corridors, there is the potential to, instead, study all corridors present within a geographic area. This approach might lead to a better understand of both design potentials and the contexts of the corridors. As another alternative, instead of selecting an area, selecting a city might provide a more appropriate approach. By looking at a city, it would be possible to study the processes and the sites that concentrate along various corridors.

References

Acker, Maarten Van. "Re-tracing the Ringscape—Infrastructure as a Mode of Urban Design." In *Infrastructural Urbanism: Addressing the In-between*, edited by Thomas Hauck, Regine Keller, and Volker. Kleinekort, 33–47. Berlin: DOM Publishers, 2011.

Allen, Stan. *Points + Lines: Diagrams and Projects for the City*. New York: Princeton Architectural Press, 1999.

American Society for Photogrammetry and Remote Sensing., and Warren R. Philipson. *Manual of Photographic Interpretation*. Bethesda, Md.: American Society of Photogrammetry and Remote Sensing, 1997.

Andersson, Sven-Ingvar, and Steen Høyer. *C. Th. Soerensen: Landscape Modernist*. Danish Architectural Press, 2001.

Angélil, Marc M., and Anna Klingmann. "Hybrid Morphologies: Infrastructure, Architecture, Landscape." *Daidalos*, no. 73 (1999): 16–25.

Appleton, Jay. "Landscape Evaluation: The Theoretical Vacuum." *Transactions of the Institute of British Geographers*, 1975, 120–23.

Appleyard, Donald, Kevin Lynch, and John R. Myer. *The View from the Road*. Cambridge: Published for the Joint Center for Urban Studies of the Massachusetts Institute of Technology and Harvard University by the M.I.T. Press, 1964.

Barboza, David. "In China, Projects to Make Great Wall Feel Small." *The New York Times*, January 12, 2015. http://www.nytimes.com/2015/01/13/business/international/in-china-projects-to-make-great-wall-feel-small-.html.

Barratt, Claire, and Ian Whitelaw. *The Spotter's Guide to Urban Engineering: Infrastructure and Technology in the Modern Landscape*. Richmond Hill, Ont. ; Buffalo, NY: Firefly Books, 2011.

B.E.F. "Highways as Scenery." *Landscape* 12, no. 2 (Winter 1962): 23–24.

Bélanger, Pierre. "Landscape as Infrastructure." *Landscape Journal* 28, no. 1 (2009): 79–95.

———. "Landscape Infrastructure." *Harvard Design Magazine*, no. 36 (2013): 154–57.

———. "Landscape Infrastructure: Urbanism Beyond Engineering." In *Infrastructure Sustainability and Design*, edited by Spiro N. Pollalis, 276–310. New York, NY: Routledge, 2012.

———. "Redefining Infrastructure." In *Ecological Urbanism*, edited by Mohsen Mostafavi and Gareth Doherty, 332–49. Baden, Switzerland: Lars Muller, 2010.

Benosky, Christopher, and Shaun O'Rourke. "Ecological Infrastructure." In *Infrastructure Sustainability and Design*, edited by Spiro N. Pollalis, 155–67. New York, NY: Routledge, 2012.

Berger, Alan. *Drosscape: Wasting Land Urban America*. New York: Princeton Architectural Press, 2007.

Berger, Alan, Dirk Sijmons, and Wouter Mikmak Foundation. *Systemic Design Can Change The World; Utopia's Practical Cousin*. Amsterdam; Baarn: SUN; Wouter Mikmak Foundation, 2009.

Berrizbeitia, Anita. "Scales of Undecidability." In *CASE: Downsview Park Toronto*, by Julia Czerniak, 116–25. Munich; New York; [Cambridge, Mass.]: Prestel ; Harvard University, Graduate School of Design, 2001.

Berry, Brian J. L., and William L. Garrison. "Cities and Freeways." *Landscape* 10, no. 3 (Spring 1961): 20–25.

Bhatia, Neeraj, InfraNet Lab (Firm), and Lateral Office (Firm). *Coupling Strategies for Infrastructural Opportunism*. New York: Princeton Architectural Press, 2010.

Brown, Catherine R., and William Morrish. "Toward a New Infrastructure." *Architecture* 82, no. 8 (1993): 35,37,39.

Brown, Hillary. *Next Generation Infrastructure: Principles for Post-Industrial Public Works*. Washington: Island Press, 2014.

Bruegmann, Robert. "Infrastructure Reconstructed." *Design Quarterly*, no. 158 (Winter 1993): 7–13.

Callejas, Luis. *Islands and Atolls*. New York: Princeton Architectural Press, 2013.

Choate, Pat., and Susan Walter. *America in Ruins: Beyond the Public Works Pork Barrel*. Washington, D.C.: Council of State Planning Agencies, 1981.

Churella, Albert J. *The Pennsylvania Railroad, Volume 1: Building an Empire, 1846-1917*. Philadelphia: University of Pennsylvania Press, 2013.

Clarke, Gilmore D. "The Parkway Idea." In *The Highway and the Landscape*, edited by William Brewster Snow, 33–55. New Brunswick, N.J.: Rutgers University Press, 1959.

Conan, Michel, ed. *Landscape Design and the Experience of Motion*. Washington, D.C.: Dumbarton Oaks Research Library and Collection, 2003.

Corner, James. "Aerial Representation: Irony and Contradiction in An Age of Precision." In *The Landscape Imagination: Collected Essays of James Corner, 1990-2010*, edited by James Corner and Alison Bick Hirsch, 133–59. New York: Princeton Architectural Press, 2014.

———. *Recovering Landscape: Essays in Contemporary Landscape Theory*. New York: Princeton Architectural Press, 1999.

———. "Terra Fluxus." In *The Landscape Urbanism Reader*, edited by Charles Waldheim, 23–33. New York: Princeton Architectural Press, 2006.

———. "The Agency of Mapping: Speculation, Critique, and Invention." In *The Landscape Imagination: Collected Essays of James Corner, 1990-2010*, edited by James Corner and Alison Bick Hirsch, 197–239. New York: Princeton Architectural Press, 2014.

———. "Three Tyrannies of Contemporary Theory." In *The Landscape Imagination: Collected Essays of James Corner, 1990-2010*, edited by Alison Bick Hirsch and James Corner, 76–109. New York: Princeton Architectural Press, 2014.

Corner, James, and Alison Bick Hirsch. *The Landscape Imagination: Collected Essays of James Corner, 1990-2010*. New York: Princeton Architectural Press, 2014.

Craib, Raymond B. *Cartographic Mexico: A History of State Fixations and Fugitive Landscapes*. Durham, N.C.: Duke University Press, 2004.

Cron, F.W. "The Art of Fitting the Highway to the Landscape." In *The Highway and the Landscape*, edited by William Brewster Snow, 78–109. New Brunswick, N.J.: Rutgers University Press, 1959.

Crowe, Sylvia. *The Landscape of Roads*. London: Architectural Press, 1960.

Culvahouse, Tim. *The Tennessee Valley Authority Design and Persuasion*. New York: Princeton Architectural Press, 2007.

Czerniak, Julia. “Looking Back at Landscape Urbanism: Speculations on Site.” In *The Landscape Urbanism Reader*, edited by Charles Waldheim, 105–24. New York: Princeton Architectural Press, 2006.

D’Ambros, Matteo, and Roberto Zancan. “Infrastructure’s Marginal Spaces and the Invention of a Prosaic Landscape—Visual Knowledge and Design.” In *Infrastructural Urbanism: Addressing the In-between*, edited by Thomas Hauck, Regine Keller, and Volker. Kleinekort, 63–81. Berlin: DOM Publishers, 2011.

Daro, Carlotta. “Wired Landscapes: Infrastructures of Telecommunication and Modern Urban Theories.” In *Infrastructural Urbanism: Addressing the In-between*, edited by Thomas Hauck, Regine Keller, and Volker. Kleinekort, 19–31. Berlin: DOM Publishers, 2011.

Davis, Timothy. “The American Motor Parkway.” *Studies in the History of Gardens & Designed Landscapes* 25, no. 4 (October 1, 2005): 219–49.

———. “The Rise and Decline of the American Parkway.” In *The World Beyond the Windshield: Roads and Landscapes in the United States and Europe*, edited by Christof Mauch and Thomas Zeller, 35–58. Athens, Ohio: Ohio University Press, 2008.

Dean, Andrea Oppenheimer. “Expressing the Infrastructure: For William Morrish, Potentially Beautiful Infrastructure Connects and Gives Form to Landscapes.” *Landscape Architecture* 93, no. 8 (2003): 92–95.

Delbene, Giacomo. “Hybridize! Rules of Engagement of Landscape and Infrastructure.” In *On Site: Landscape Architecture in Europe*, 249–51, 2009.

Diamond, D., and N. Spend. “Infrastructure and Regional Development: Theories.” *Built Environment* 10, no. 4 (1984): 262–69.

Dramstad, Wenche E., James D. Olson, and Richard T. T. Forman. *Landscape Ecology Principles in Landscape Architecture and Land-Use Planning*. Washington, DC: Harvard University Graduate School of Design ; Island Press ; American Society of Landscape Architects, 1996.

Easterling, Keller. *Extrastatecraft: The Power of Infrastructure Space*. London; New York: Verso, 2014.

Eberhard, John P., and Abram B. Bernstein. “A Conceptual Framework for Thinking about Urban Infrastructure.” *Built Environment* 10, no. 4 (1984): 253–61.

Edwards, Paul N. “Infrastructure and Modernity: Force, Time, and Social Organization in the History of Sociotechnical Systems.” In *Modernity and Technology*, edited by Thomas J. Misa, Philip. Brey, and Andrew. Feenberg, 185–225. Cambridge, Mass.: MIT Press, 2003.

Forman, Richard T.T. “Infrastructure and Nature: Reciprocal Effects and Patterns for Our Future.” In *Infrastructure Sustainability and Design*, edited by Spiro N. Pollalis, 35–49. New York, NY: Routledge, 2012.

———. *Land Mosaics: The Ecology of Landscapes and Regions*. New York: Cambridge University Press, 1995.

———. “Road Ecology: A Solution for the Giant Embracing Us.” *Landscape Ecology* 13, no. 4 (1998): III – V.

———. “Road Ecology’s Promise: What’s around the Bend?” *Environment: Science and Policy for Sustainable Development* 46, no. 4 (2004): 8–21.

———. “Roadside Redesigns: Woody and Variegated.” *Harvard Design Magazine*, 2006.

Forman, Richard T.T., and Lauren E. Alexander. “Roads and Their Major Ecological Affects.” *Annual Review of Ecology and Systematics*, 1998, 207–31.

Forman, Richard T.T., Daniel Sperling, John A. Bissonette, Athony P. Clevenger, Carol D. Cutshall, Virginia H. Dale, Lenore Fahrig, et al. *Road Ecology: Science and Solutions*. Island Press, 2003.

Foster, Jennifer. “Off Track, in Nature: Constructing Ecology on Old Rail Lines in Paris and New York.” *Nature and Culture* 5, no. 3 (2010): 316–37.

Foster, Jeremy. “Spectral Denivelations: La Mémoire Du Ail and Topographical Excess at the Jardins d’Éole.” *Journal of Landscape Architecture* 7, no. 1 (May 1, 2012): 68–83.

Gakenheimer, Ralph. “Infrastructure Shortfall: The Institutional Problems.” *Journal of the American Planning Association* 55, no. 1 (1989): 14–23.

Gandy, Matthew. “Marginalia: Aesthetics, Ecology, and Urban Wastelands.” *Annals of the Association of American Geographers* 103, no. 6 (2013): 1301–16.

Garrison, William L. *Studies of Highway Development and Geographic Change*. Seattle: University of Washington Press, 1959.

Gastil, Ray. "Prospect Parks: Walking the Promenade Planteé and the High Line." *Studies in the History of Gardens & Designed Landscapes* 33, no. 4 (October 1, 2013): 280–89.

Girot, Christophe. "About Topology: An Integrated Comprehension of Landscape." *Topos: European Landscape Magazine* 82 (2013): 24.

Gobel, David. "Introduction." *Modulus* 17 (1984): 1.

Granick, Harry. *Underneath New York*. New York, Toronto: Rhinehart & Co., 1947.

Guldi, Jo. *Roads to Power Britain Invents the Infrastructure State*. Cambridge, Mass.: Harvard University Press, 2012.

Halprin, Lawrence. *Freeways*. New York: Reinhold Pub. Corp., 1966.

Harvey, David. *The Condition of Postmodernity: An Enquiry Into the Origins of Cultural Change*. Oxford [England]; Cambridge, Mass., USA: Blackwell, 1990.

Hauck, Thomas, Regine Keller, and Volker. Kleinekort, eds. *Infrastructural Urbanism: Addressing the In-between*. Berlin: DOM Publishers, 2011.

Hennessey, Desmond. "Motor Roads in the Modern Landscape." *Architectural Design* 26 (1956): 275–79.

Herold, Martin, XiaoHang Liu, and Keith C. Clarke. "Spatial Metrics and Image Texture for Mapping Urban Land Use." *Photogrammetric Engineering & Remote Sensing* 69, no. 9 (2003): 991–1001.

Hicks, Jay. "Leveraging Infrastructure as Open Space." *Urban Land* 67, no. 8 (2008): 99–103.

"High-Speed Railroading." *The Economist*, July 22, 2010. http://www.economist.com/node/16636101.

Hood, Walter. "Landscape as Social Infrastructure: Hybrid Modifications—Scraping, Weaving, Stratifying, and Lumping." In *The MESH Book: Landscape/infrastructure*, edited by Julian R. Raxworthy and Jessica Blood. RMIT Publishing, 2004.

Hough, Michael. *City Form and Natural Process: Towards a New Urban Vernacular*. New York: Van Nostrand Reinhold, 1984.

Hoyer, Steen A.B. “Things Take Time and Time Takes Things: The Danish Landscape.” In *Recovering Landscape: Essays in Contemporary Landscape Theory*, by James Corner, 68–77. New York: Princeton Architectural Press, 1999.

Huls, Mary Ellen. *Highway Landscape Architecture: A Bibliography*. Monticello, Ill.: Vance Bibliographies, 1986.

Hung, Ying-Yu. “Landscape Infrastructure: Systems of Contingency, Flexibility, and Adaptability.” In *Landscape Infrastructure Case Studies by SWA*, edited by Ying-Yu Hung and Gerdo Aquino, 14–19. Basel: Birkhäuser, 2013.

Hung, Ying-Yu, and Gerdo Aquino, eds. *Landscape Infrastructure Case Studies by SWA*. Basel: Birkhäuser, 2013.

Hunt, John Dixon. *Historical Ground: The Role of History in Contemporary Landscape Architecture*. London ; New York: Routledge, 2014.

———. “Moving Along in the Automobile.” In *The Afterlife of Gardens*, 173–90. London: Reaktion Books, 2004.

———. *The Afterlife of Gardens*. London: Reaktion Books, 2004.

Jellicoe, G.A. “Motorways: Their Landscaping, Design and Appearance.” *Journal of the Town Planning Institute* 44, no. 20 (1958): 274–83.

Jellicoe, Geoffrey. *Motopia: A Study in the Evolution of Urban Landscape*. New York: Praeger, 1961.

Jensen, John R. *Remote Sensing of the Environment: An Earth Resource Perspective*. Upper Saddle River, NJ: Pearson Prentice Hall, 2007.

Johnson, Wallace A. “Preserving the Scenic Qualities of the Roadside.” In *The Highway and the Landscape*, edited by William Brewster Snow, 110–30. New Brunswick, N.J.: Rutgers University Press, 1959.

Kaplan, Marshall. “Hard Choices: Responding to America’s Infrastructure Problems.” *Built Environment* 10, no. 4 (1984): 245–52.

Kelsch, Paul. “Cultivating Modernity, History, and Nature.” *Studies in the History of Gardens & Designed Landscapes* 31, no. 4 (October 1, 2011): 294–310.

Knecht, Barbara. “Urban Infrastructure: The ‘out of Sight, out of Mind’ Mentality Is an Outmoded Concept.” *Architectural Record* 190, no. 6 (2002): 151–54,156,158.

Koolhaas, Rem. “What Ever Happened to Urbanism?” In *S,M,L,XL, OMA*. New York: The Monicelli Press, 1995.

Kuitert, Wybe. “Urban Landscape Systems Understood by Geo-History Map Overlay.” *Journal of Landscape Architecture* 8, no. 1 (May 1, 2013): 54–63.

Kullmann, Karl. “Thin Parks / Thick Edges: Towards a Linear Park Typology for (post)infrastructural Sites.” *Journal of Landscape Architecture* 6, no. 2 (September 1, 2011): 70–81.

Leatherbarrow, David. *The Roots of Architectural Invention: Site, Enclosure, Materials*. Cambridge [England]; New York, NY, USA: Cambridge University Press, 1993.

Lefsky, Michael A., Warren B. Cohen, Geoffrey G. Parker, and David J. Harding. “Lidar Remote Sensing for Ecosystem Studies.” *Bioscience* 52, no. 1 (January 2002): 19–30.

LePartner, Barry B. *Too Big to Fail: America’s Failing Infrastructure and the Way Forward*. New York: Foster Publishing, 2010.

Lewis, Tom. *Divided Highways: Building the Interstate Highways, Transforming American Life*. New York, N.Y.: Viking, 1997.

Lund, Annemarie. *Guide to Danish Landscape Architecture, 1000-2003*. Arkitektens Forlag, 2003.

Lynch, Kevin. *The Image of the City*. Cambridge, Mass.: MIT Press, 1960.

Lyster, Clare. “Landscapes of Exchange: Re-Articulating Site.” In *The Landscape Urbanism Reader*, edited by Charles Waldheim, 219–37. New York: Princeton Architectural Press, 2006.

Mauch, Christof, and Thomas Zeller, eds. *The World Beyond the Windshield: Roads and Landscapes in the United States and Europe*. Athens, Ohio: Ohio University Press, 2008.

McHarg, Ian L. *Design with Nature*. Garden City, N.Y.: Published for the American Museum of Natural History [by] the Natural History Press, 1969.

Meadows, W.J., and P.M. Jackson. “Infrastructure and Regional Development: Empirical Findings.” *Built Environment* 10, no. 4 (1984): 270–81.

Meyer, Elizabeth. “The Expanded Field of Landscape Architecture.” In *Ecological Design and Planning*, 45–79. New York: Wiley, 1997.

Meyer, Han. *City and Port: Urban Planning as a Cultural Venture in London, Barcelona, New York, and Rotterdam : Changing Relations between Public Urban Space and Large-Scale Infrastructure*. Utrecht: International Books, 1999.

Miller, Jonathan D. “Infrastructure: World Overview.” *Urban Land* 66, no. 10 (2007): 152–57.

Morgan, Jessica L., Sarah E. Gergel, and Nicholas C. Coops. “Aerial Photography: A Rapidly Evolving Tool for Ecological Management.” *BioScience* 60, no. 1 (2010): 47–59.

Morrish, William R., and Catherine R. Brown. “Putting Place Back into Infrastructure.” *Landscape Architecture* 85, no. 6 (1995): [50] – 53.

Mossop, Elizabeth. “Landscapes of Infrastructure.” In *The Landscape Urbanism Reader*, edited by Charles Waldheim, 162–77. New York: Princeton Architectural Press, 2006.

Mumford, Lewis. *The Highway and the City*. New York: Harcourt, Brace & World, 1963.

Newton, Norman T. *Design on the Land: The Development of Landscape Architecture*. Cambridge, Mass.: Belknap Press of Harvard University Press, 1971.

Nicolin, Pierluigi. “Paesaggi E Infrastrutture = Landscapes and Infrastructures.” *Lotus International*, no. 139 (2009): 16–23.

Nixon, Ron. “$11 Billion Later, High-Speed Rail Is Inching Along.” *The New York Times*, August 6, 2014. http://www.nytimes.com/2014/08/07/us/delays-persist-for-us-high-speed-rail.html.

Odum, Eugene P., and Howard T. Odum. *Fundamentals of Ecology*. Philadelphia & London: W.B. Saunders Co., 1959.

Oremus, Will. “Requiem for a Train.” *Slate*, December 7, 2011. http://www.slate.com/articles/technology/technocracy/2011/12/high_speed_rail_is_dead_in_america_should_we_mourn_it_.html.

Osnos, Evan. “Boss Rail.” *The New Yorker*, October 15, 2012. http://www.newyorker.com/magazine/2012/10/22/boss-rail.

Parolotto, Frederico. “Reversible Infrastructure.” *Harvard Design Magazine*, no. 37 (2014): 112–17.

Paul, Rahul. “From Object Line to Vector Field—The Social Instrument.” In *Infrastructural Urbanism: Addressing the In-between*, edited by Thomas Hauck, Regine Keller, and Volker. Kleinekort, 49–61. Berlin: DOM Publishers, 2011.

Picon, Antoine. *French architects and engineers in the Age of Enlightenment*. Cambridge [England]; New York, NY, USA: Cambridge University Press, 1992.

———. “Nature, Infrastructures, and the Urban Condition.” In *Ecological Urbanism*, edited by Mohsen Mostafavi and Gareth Doherty, 520–21. Baden, Switzerland: Lars Muller, 2010.

Pollak, Linda. “Constructed Ground: Questions of Scale.” In *The Landscape Urbanism Reader*, edited by Charles Waldheim, 125–39. New York: Princeton Architectural Press, 2006.

———. “Il Paesaggio per Il Recupero Urbano: Infrastrutture per Uno Spazio Quotidiano Che Comprenda La Natura = Landscape for Urban Reclamation: Infrastructures for the Everyday Space That Includes Nature.” *Lotus International*, no. 128 (2006): [32] – 45.

Poole, Kathy. “‘Civitas Oecologie’: Infrastructure in the Ecological City.” *Harvard Architecture Review* 10 (1998): [126] – 145.

———. “Potentials for Landscape as Infrastructure, Part I: Six-and-a-Half Degrees of Infrastructure.” In *The MESH Book: Landscape/infrastructure*, edited by Julian R. Raxworthy and Jessica Blood. RMIT Publishing, 2004.

Priestley, Thomas. “The Field of Visual Analysis and Resource Management: A Bibliographic Analysis and Perspective.” *Landscape Journal* 2, no. 1 (1983): 52–59.

Pritchard, Sara B. *Confluence: The Nature of Technology and the Remaking of the Rhône*. Cambridge, Mass.: Harvard University Press, 2011.

———. “Joining Environmental History with Science and Technology Studies: Promises, Challenges, and Contributions.” edited by Dolly Jorgensen, Finn Arne

Jorgensen, and Sara B. Pritchard, 1–20. Pittsburgh, Pennsylvania: University of Pittsburgh Press, 2013.

Pushkarev, B. "The Esthetics of Freeway Design." *Landscape* 10, no. 2 (1960): 7–15.

Qviström, Mattias. "Network Ruins and Green Structure Development: An Attempt to Trace Relational Spaces of a Railway Ruin." *Landscape Research* 37, no. 3 (June 1, 2012): 257–75.

Raxworthy, Julian R., and Jessica Blood. *The MESH Book: Landscape/infrastructure*. RMIT Publishing, 2004.

Reed, Chris. "Public Works Practice." In *The Landscape Urbanism Reader*, edited by Charles Waldheim, 267–85. New York: Princeton Architectural Press, 2006.

Repishti, Francesco. "Scavo E Sovrapposizione = Excavation and Superimposition." *Lotus International*, no. 139 (2009): 115–21.

Rinne, Katherine Wentworth. *The Waters of Rome: Aqueducts, Fountains, and the Birth of the Baroque City*. First Edition edition. New Haven: Yale University Press, 2011.

Rocca, Alessandro. "Atlante: Il Nuovo Paesaggio Delle Infrastrutture in Europa = Atlas: The Contemporary Landscape of Europe's Infrastructures." *Lotus International*, no. 110 (2001): 126–43.

Rohatyn, Felix G. *Bold Endeavors: How Our Government Built America, and Why It Must Rebuild Now*. Simon and Schuster, 2009.

Rosenberg, Elissa. "Public Works and Public Space: Rethinking the Urban Park." *Journal of Architectural Education* 50, no. 2 (November 1, 1996): 89–103.

Rowe, Colin, and Fred Koetter. *Collage City*. Cambridge, Mass.: MIT Press, 1978.

Sargent, C. *Britain's Railway Vegetation*. Cambridge: Institute of Terrestrial Ecology, 1984.

Sawyer, Chris. "Territorial Infrastructure." In *The MESH Book: Landscape/infrastructure*, edited by Julian R. Raxworthy and Jessica Blood. RMIT Publishing, 2004.

Scott, James C. *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed*. New Haven: Yale University Press, 1999.

Scott, Wayne. “Case History of a Super Highway.” *Landscape* 6, no. 2 (Winter 1956): 8–12.

Seely, Bruce Edsall. *Building the American Highway System: Engineers as Policy Makers*. Philadelphia: Temple University Press, 1987.

Shaffer, Dennis, Andrew Maynor, and Windy Roy. “The Visual Perception of Lines on the Road.” *Perception & Psychophysics* 70, no. 8 (November 2008): 1571–80.

Shannon, Kelly, and Marcel Smets. *The Landscape of Contemporary Infrastructure*. Rotterdam: NAI, 2010.

———. “Towards Integrating Infrastructure and Landscape: In Order to Function, Fit and Be Acceptable, Infrastructure Needs to Enhance the Quality of the Landscape - Three Major Design Approaches Are Overwhelmingly Evident in a Review of Exemplary Built Projects from around the Globe.” *Topos: The International Review of Landscape Architecture and Urban Design*, no. 74 (2011): 64–71.

Simon, Jacques. “The Road as a Line, The Landscape as a Script.” *Topos*, no. 15 (1996): 100–106.

Smith, Ken. “Linear Landscapes: Corridors, Conduits, Strips, Edges, and Segues.” *Harvard Design Magazine*, Winter/Spring 1999, 77–80.

Snow, William Brewster. *The Highway and the Landscape*. New Brunswick, N.J.: Rutgers University Press, 1959.

Solá-Morales, Ignasi. “Terrain Vague.” In *Anyplace*, edited by Cynthia C. Davidson. Cambridge, Mass.: The MIT Press, 1995.

Sousa Matos, Rute. “Urban Landscape: Interstitial Spaces.” *Landscape Review* 13, no. 1 (2009): 61–71.

Spirn, Anne Whiston. *The Granite Garden: Urban Nature and Human Design*. New York: Basic Books, 1984.

Spirn, Anne Whiston. *Vacant Land: A Resource for Reshaping Urban Neighborhoods*. West Philadelphia Landscape Plan (Department of Landscape Architecture and Regional Planning, University of Pennsylvania), 1990.

Star, Susan Leigh. “The Ethnography of Infrastructure.” *American Behavioral Scientist* 43, no. 3 (November 1, 1999): 377–91.

Stilgoe, John R. “Garden.” In *Metropolitan Corridor: Railroads and the American Scene*, 223–44. New Haven; London: Yale University Press, 1985.

———. *Metropolitan Corridor: Railroads and the American Scene*. New Haven; London: Yale University Press, 1985.

Stoll, Katrina., Scott. Lloyd, and Stan. Allen. *Infrastructure as Architecture: Designing Composite Networks*. Berlin: Jovis, 2010.

Strang, Gary L. “Infrastructure as Landscape.” *Places* 10, no. 3 (July 1, 1996): 8–15.

———. “Notes from Underground.” *Landscape Architecture* 85, no. 6 (1995): 33–35.

Swaffield, Simon, and M. Elen Deming. “Research Strategies in Landscape Architecture: Mapping the Terrain.” *JoLA - Journal of Landscape Architecture* 2011, no. 11 (April 2011): 34–45.

Swift, Earl. *The Big Roads: The Untold Story of the Engineers, Visionaries, and Trailblazers Who Created the American Superhighways*. Reprint edition. Boston: Mariner Books, 2012.

Tatom, Jacqueline. “Urban Highways and the Reluctant Public Realm.” In *The Landscape Urbanism Reader*, edited by Charles Waldheim, 178–95. New York: Princeton Architectural Press, 2006.

Thayer, Robert L. *Gray World, Green Heart: Technology, Nature, and Sustainable Landscape*. New York: Wiley, 1994.

———. “Increasingly Invisible Infrastructure.” *Landscape Architecture* 85, no. 6 (1995): 136.

Thompson, Ian Hamilton. “Ten Tenets and Six Questions for Landscape Urbanism.” *Landscape Research* 37, no. 1 (February 1, 2012): 7–26.

Trancik, Roger. *Finding Lost Space: Theories of Urban Design*. New York: Van Nostrand Reinhold, 1986.

Tunnard, Christopher., and B. S. Pushkarev. *Man-Made America: Chaos or Control?: An Inquiry into Selected Problems of Design in the Urbanized Landscape*. New Haven: Yale University Press, 1963.

Urban Advisors to the Federal Highway Administrator (U.S.). *The Freeway in the City: Principles of Planning and Design: A Report to the Secretary, Department of Transportation*. Washington, D.C.: Department of Transportation, 1968.

Van Bohemen, Hein. "Infrastructure, Ecology and Art." *Landscape and Urban Planning* 59, no. 4 (2002): 187–201.

Waldheim, Charles, ed. *The Landscape Urbanism Reader*. New York: Princeton Architectural Press, 2006.

Wall, Alex. "Programming the Urban Surface." In *Recovering Landscapes*, edited by James Corner, 233–49. New York: Princeton Architectural Press, 1999.

Williams, A. T., and C. D. Lavalle. "Coastal Landscape Evaluation and Photograph." *Journal of Coastal Research* 6, no. 4 (October 1, 1990): 1011–20.

Williams, Rosalind. "Cultural Origins and Environmental Implications of Large Technological Systems." *Science in Context* 6, no. 02 (1993): 377–403.

Wilson, William Bender. *History of the Pennsylvania Railroad Company: With Plan of Organization, Portraits of Officials, and Biographical Sketches*. Philadelphia: H. T. Coates & company, 1899.

Woollen, Malcolm. "Les Jardins d'Éole: Extending the Picturesque." *Studies in the History of Gardens & Designed Landscapes* 33, no. 4 (October 1, 2013): 290–304.

Zerubavel, Eviatar. *Time Maps: Collective Memory and the Social Shape of the Past*. University of Chicago Press, 2012.

Zube, Ervin H., James L. Sell, and Jonathan G. Taylor. "Landscape Perception: Research, Application and Theory." *Landscape Planning* 9, no. 1 (1982): 1–33.

Appendix A:
Interstate 80 Linear Site Catalog

Sites along Interstate 80 are presented in a figure-ground diagram as the sites exist along the length of the corridor. A single dashed line indicates that the corridor continues on the next page; a double dashed line indicates where the corridor continues on that page.

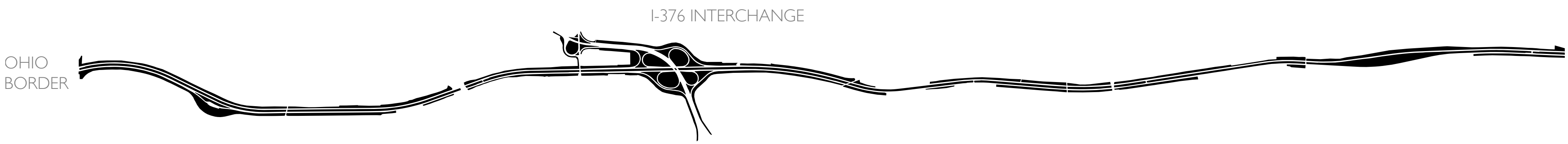
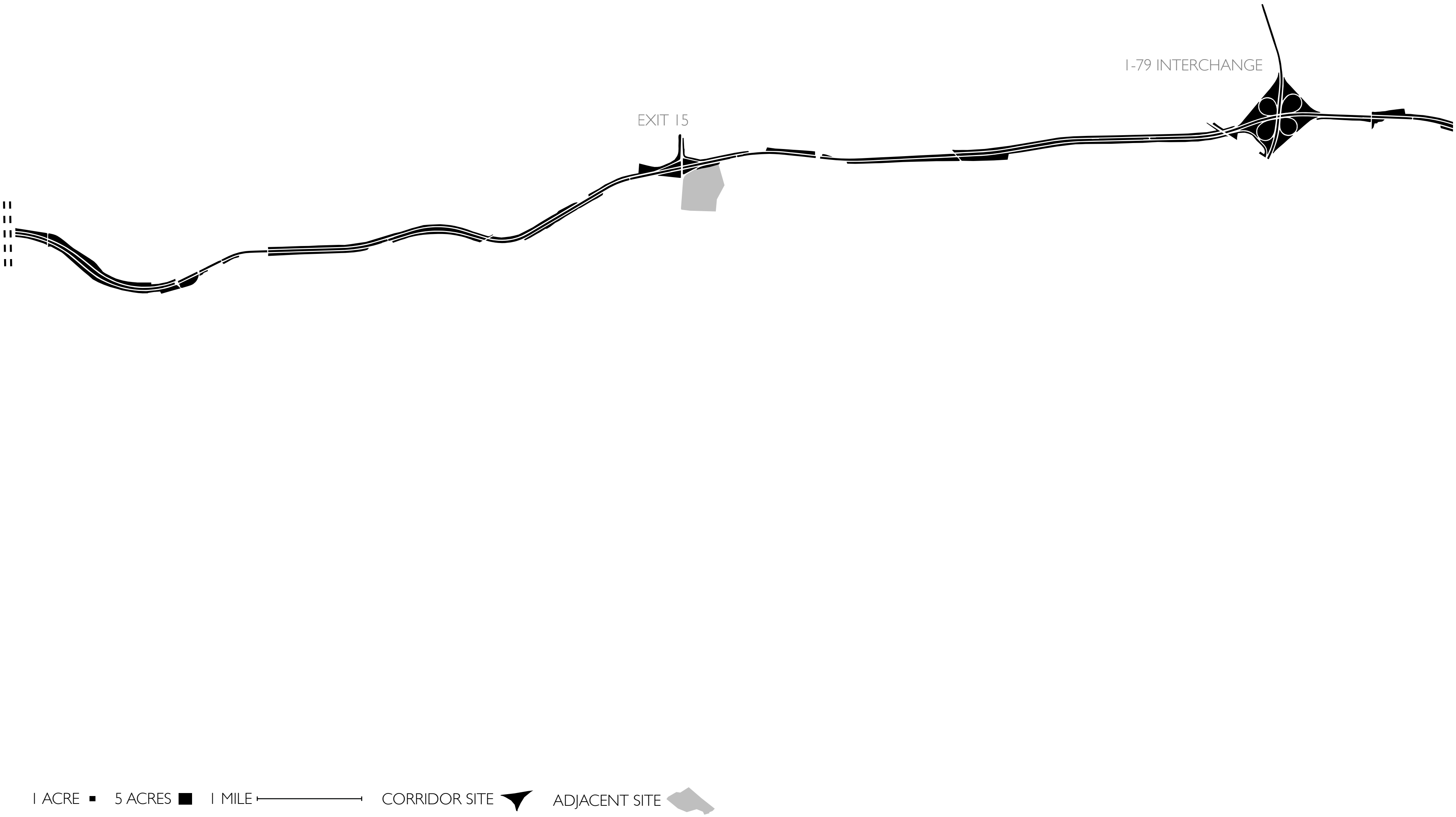
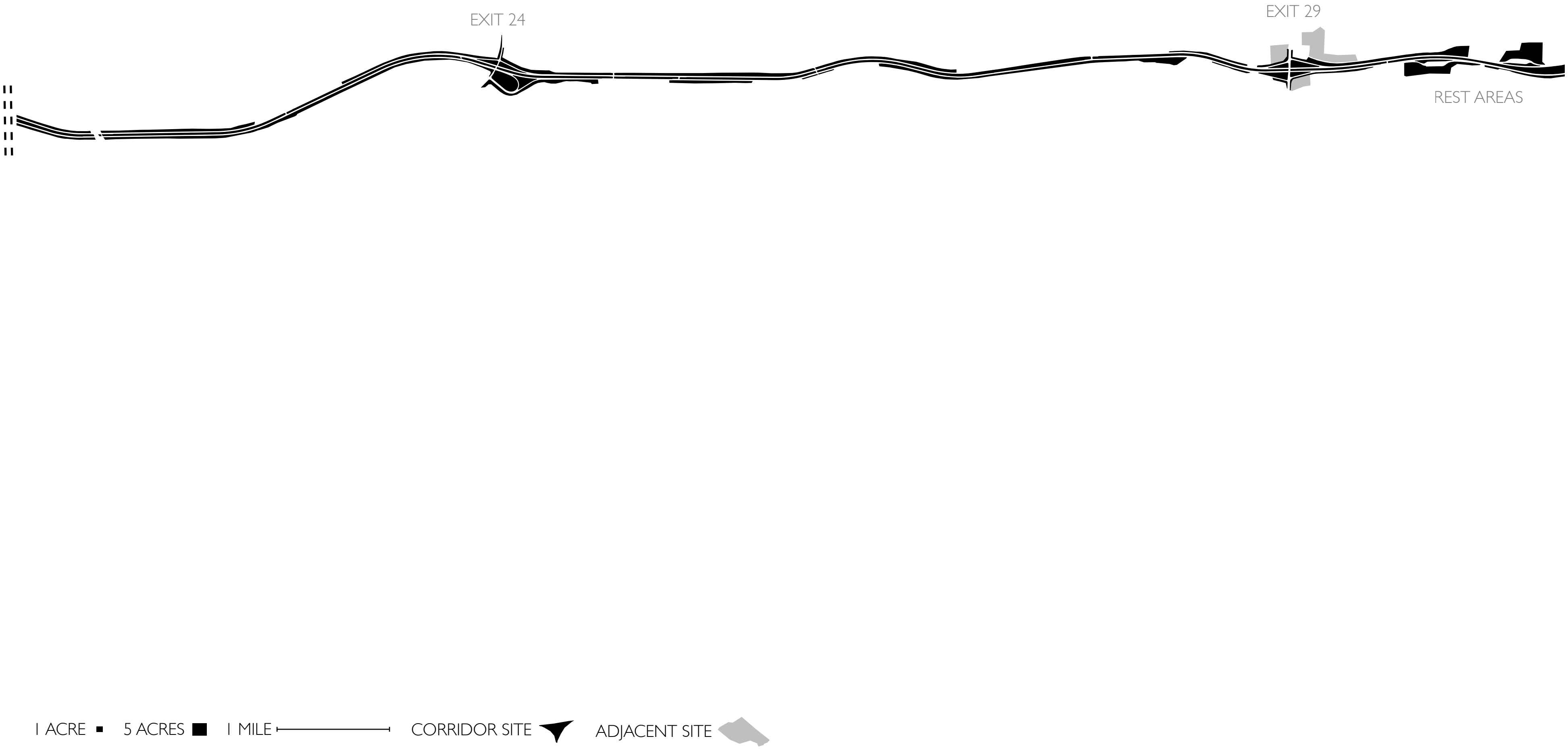
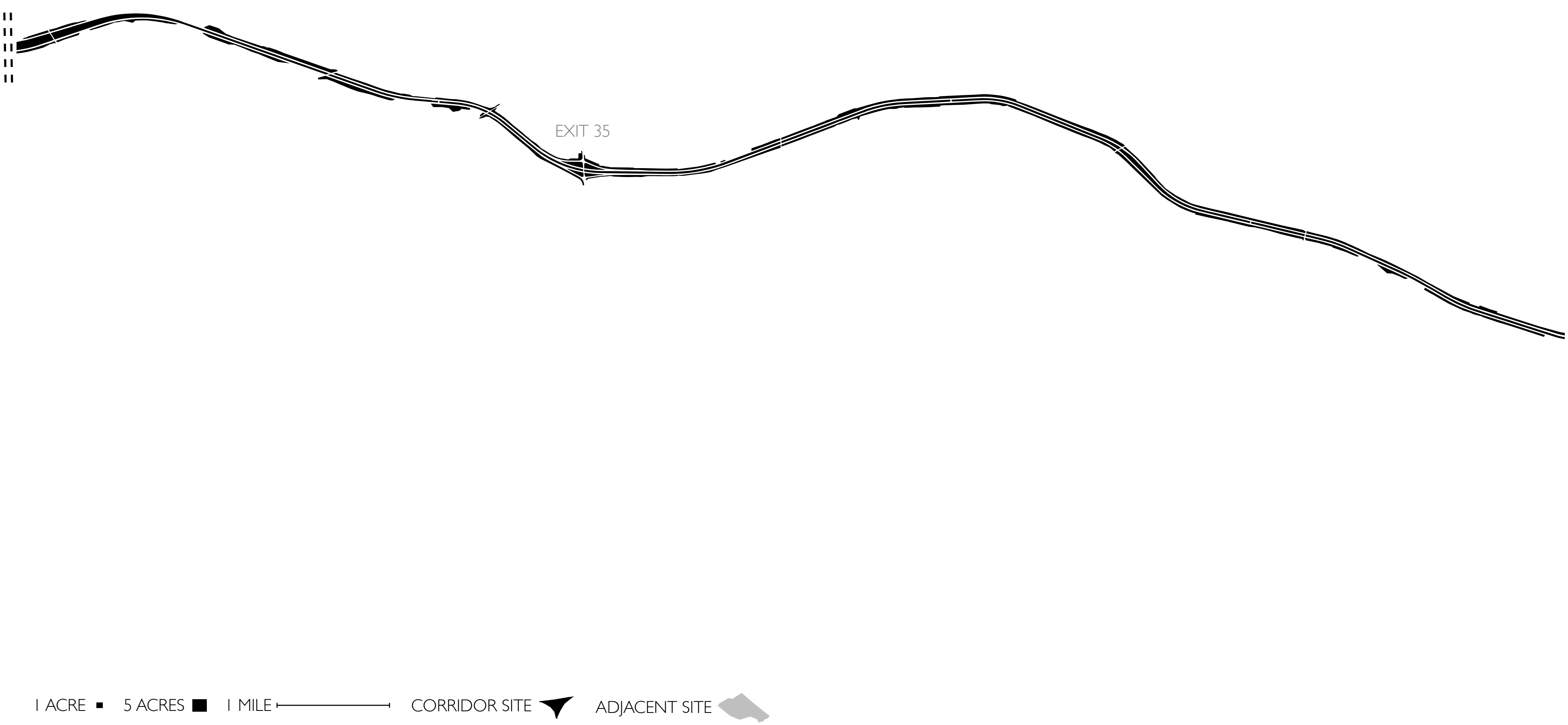


Figure 92 Interstate 80 Linear Site Catalog

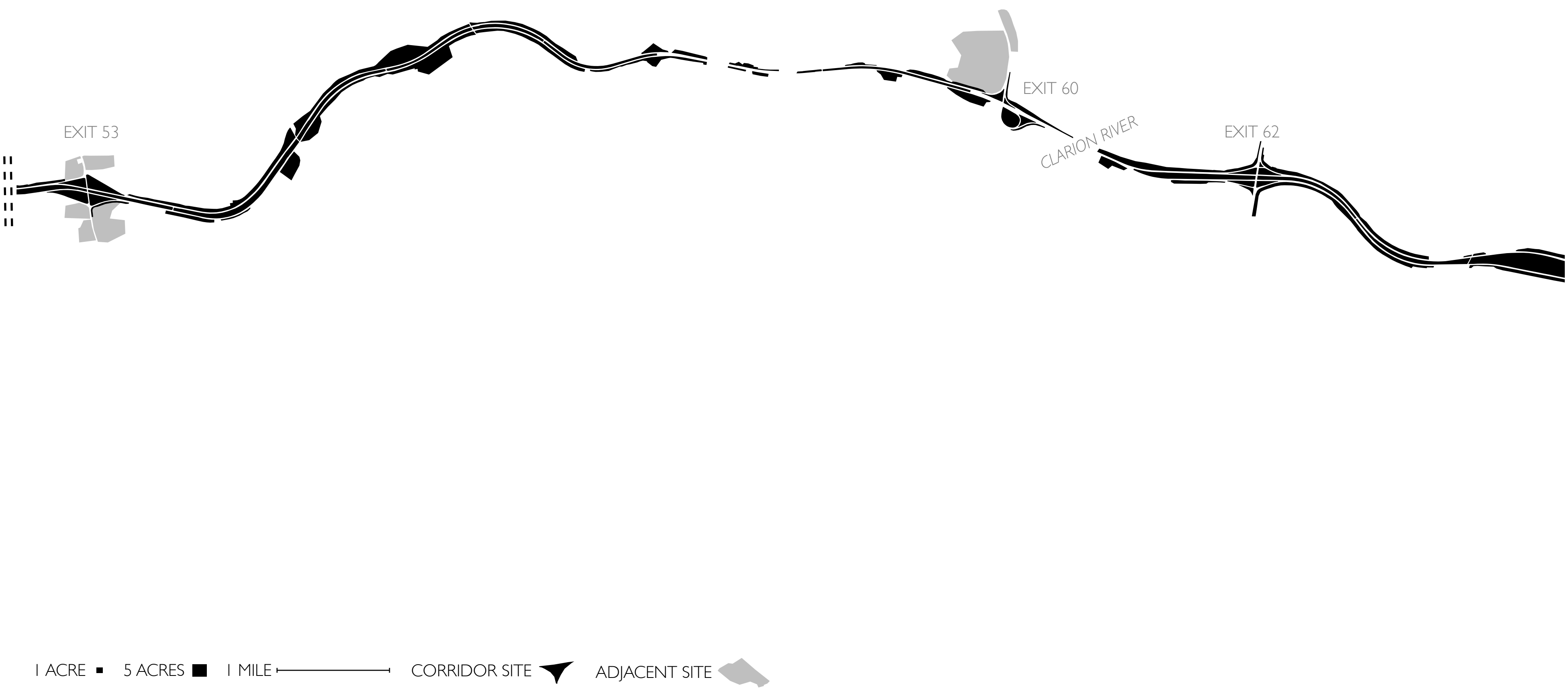
1 ACRE ▪ 5 ACRES ■ 1 MILE CORRIDOR SITE ADJACENT SITE

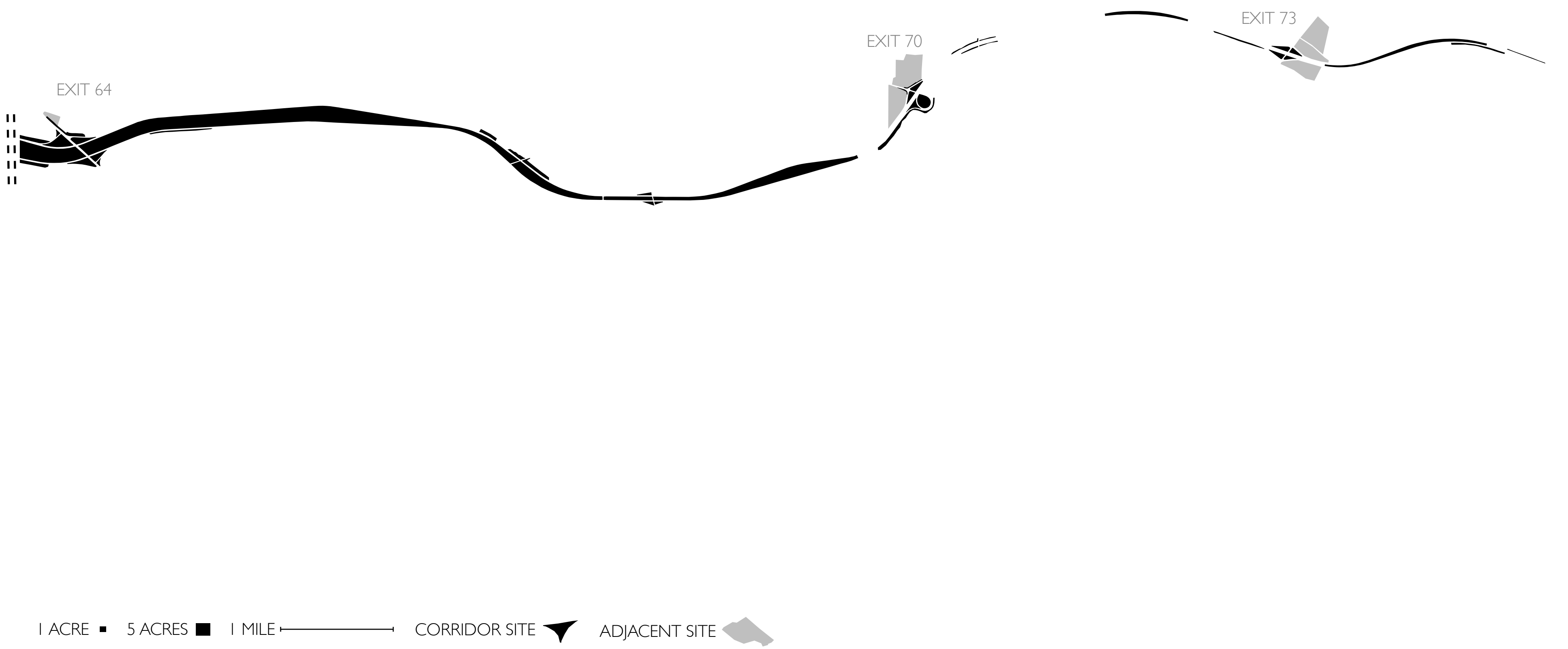

I-79 INTERCHANGE
EXIT 15
I ACRE
5 ACRES
I MILE
CORRIDOR SITE
ADJACENT SITE

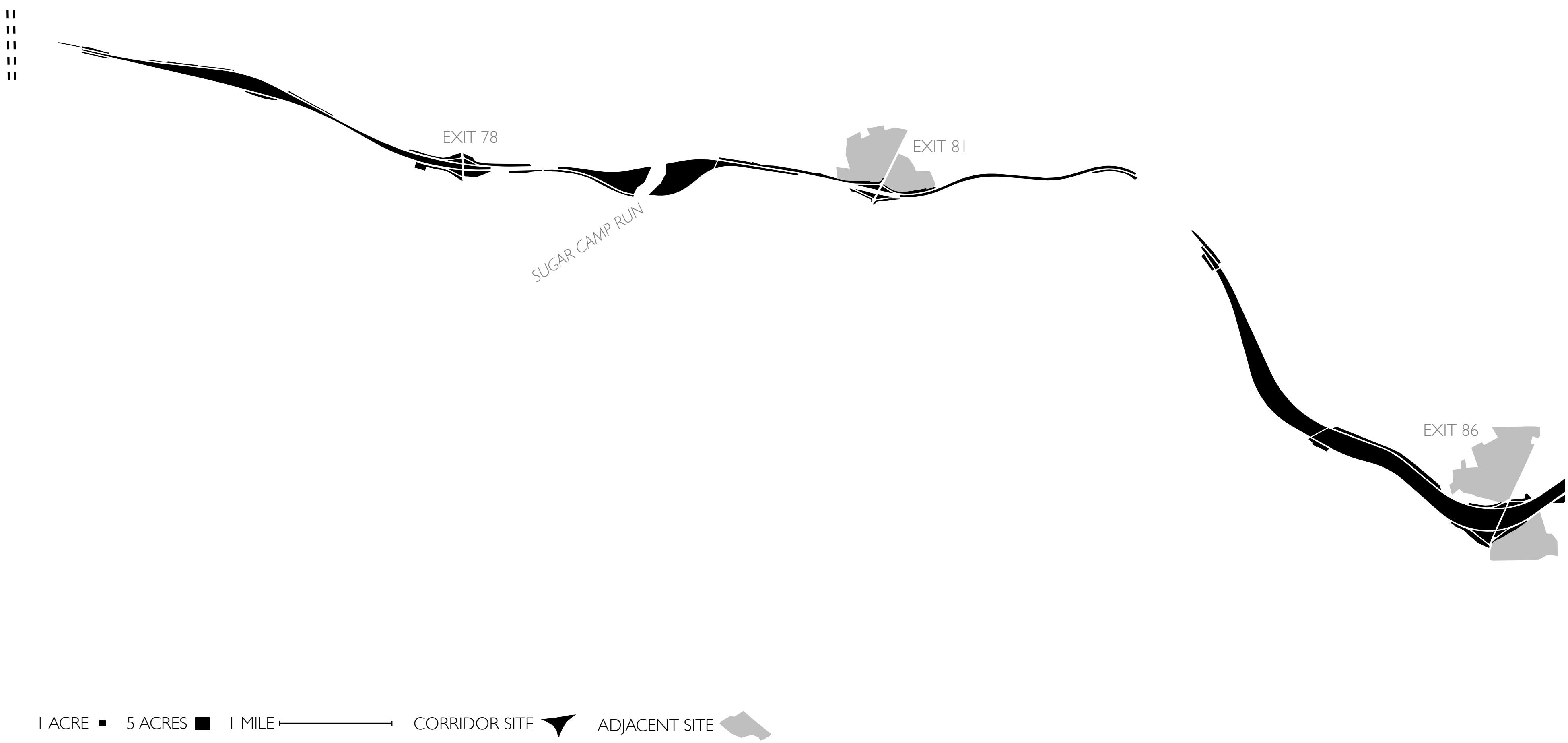

EXIT 24
EXIT 29
REST AREAS
1 ACRE
5 ACRES
1 MILE
CORRIDOR SITE
ADJACENT SITE

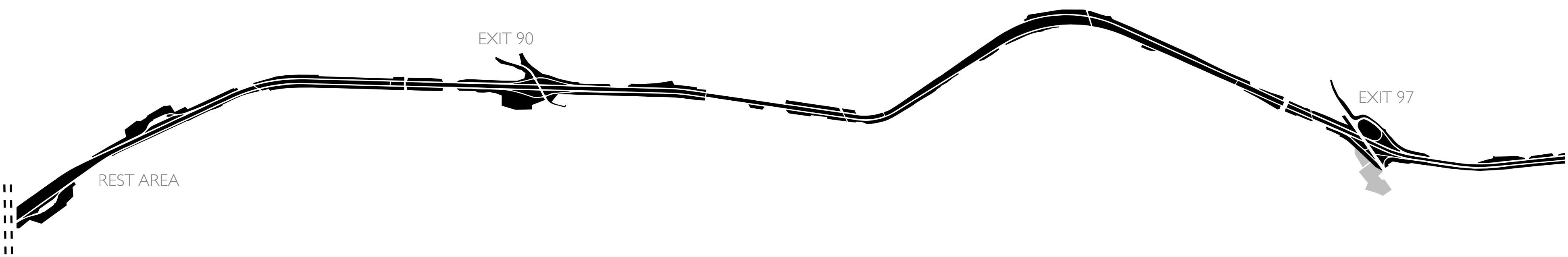

EXIT 35
1 ACRE
5 ACRES
1 MILE
CORRIDOR SITE
ADJACENT SITE


EXIT 42
ALLEGHENY RIVER
EXIT 45
1 ACRE
5 ACRES
1 MILE
CORRIDOR SITE
ADJACENT SITE

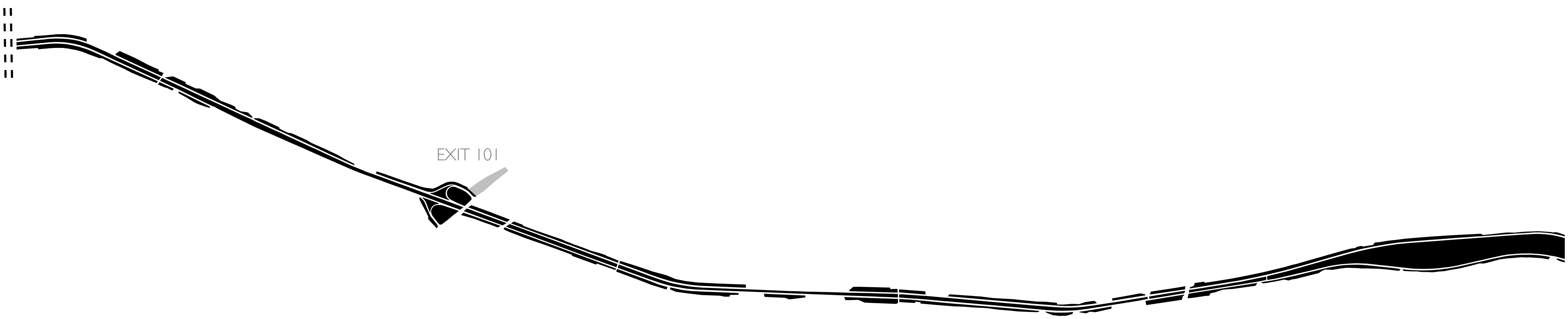

EXIT 53
EXIT 60
CLARION RIVER
EXIT 62
1 ACRE
5 ACRES
1 MILE
CORRIDOR SITE
ADJACENT SITE


EXIT 64
EXIT 70
EXIT 73
1 ACRE
5 ACRES
1 MILE
CORRIDOR SITE
ADJACENT SITE

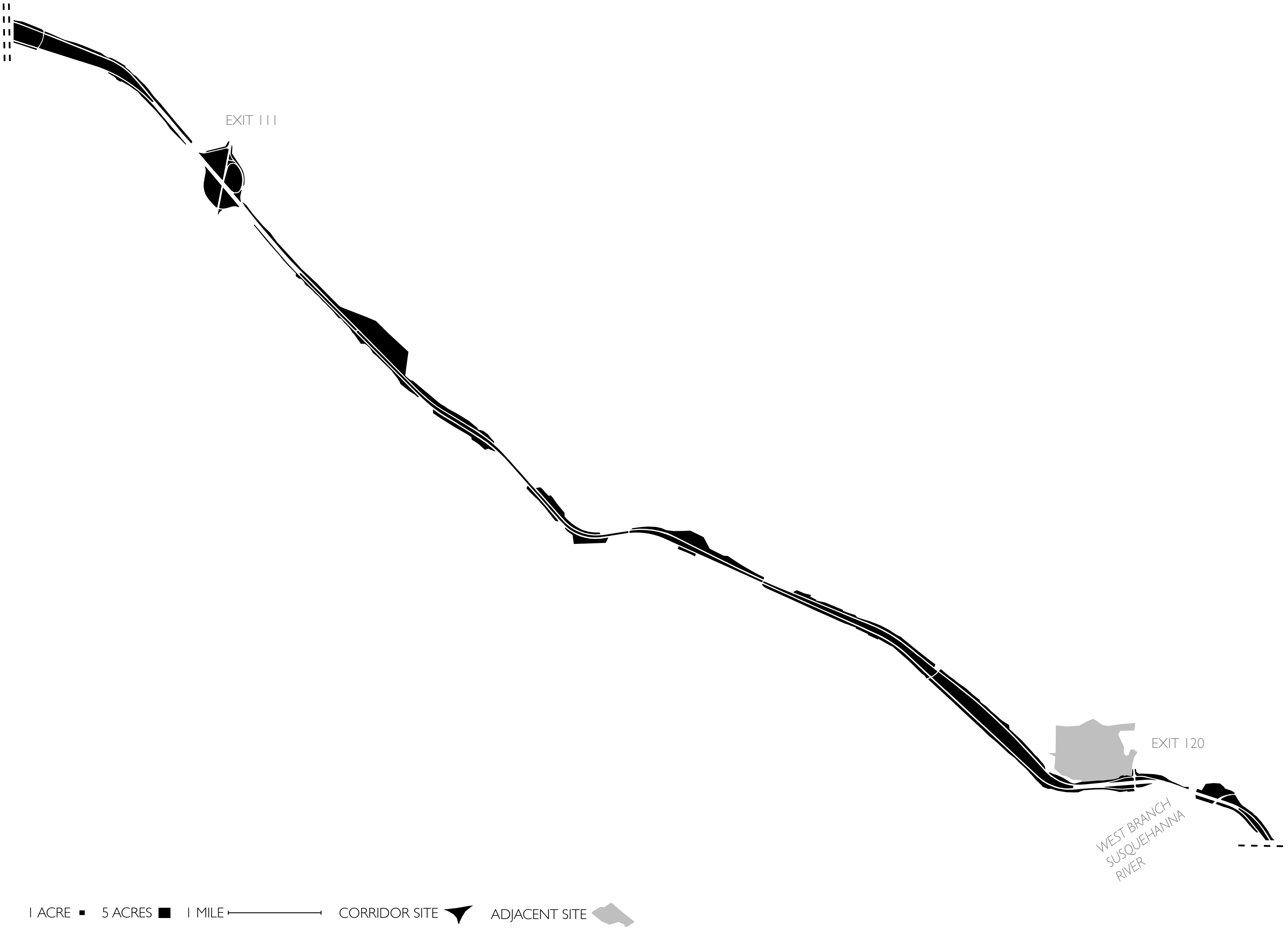

EXIT 78
EXIT 81
SUGAR CAMP RUN
EXIT 86
1 ACRE
5 ACRES
1 MILE
CORRIDOR SITE
ADJACENT SITE

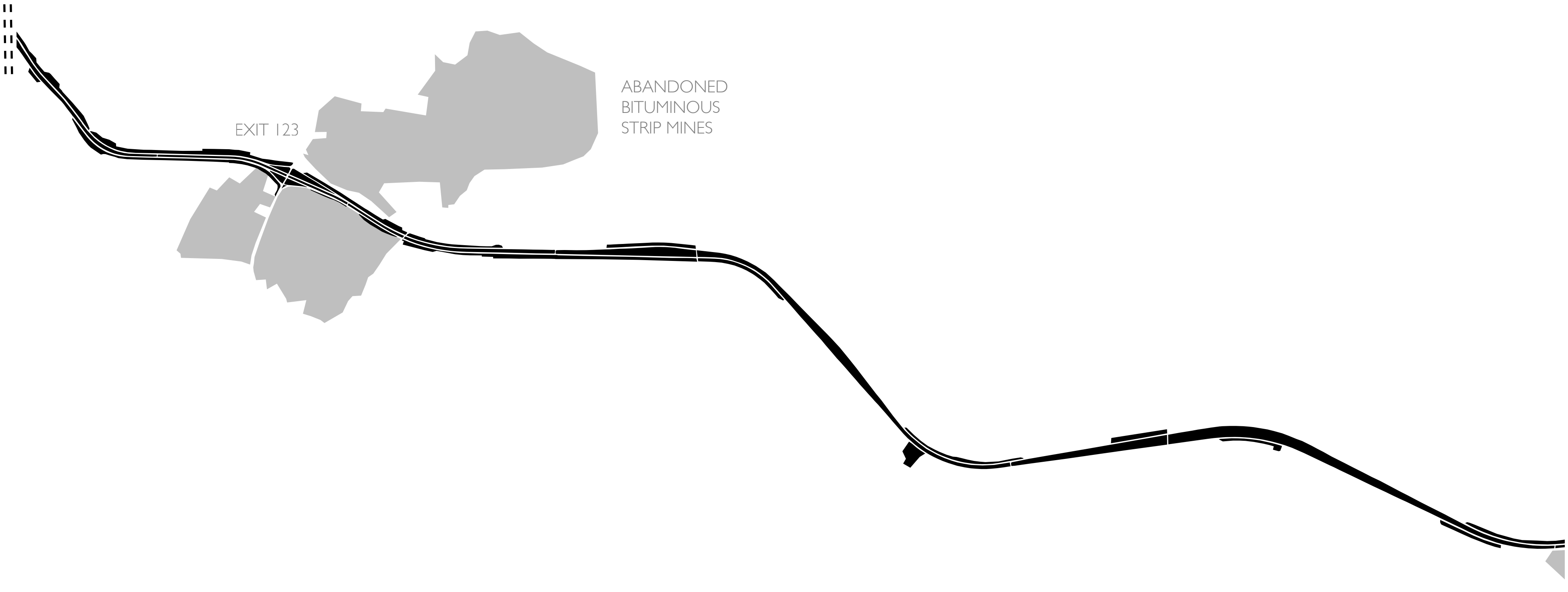


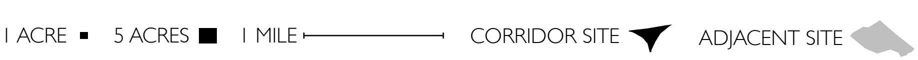
I ACRE 5 ACRES I MILE CORRIDOR SITE ADJACENT SITE

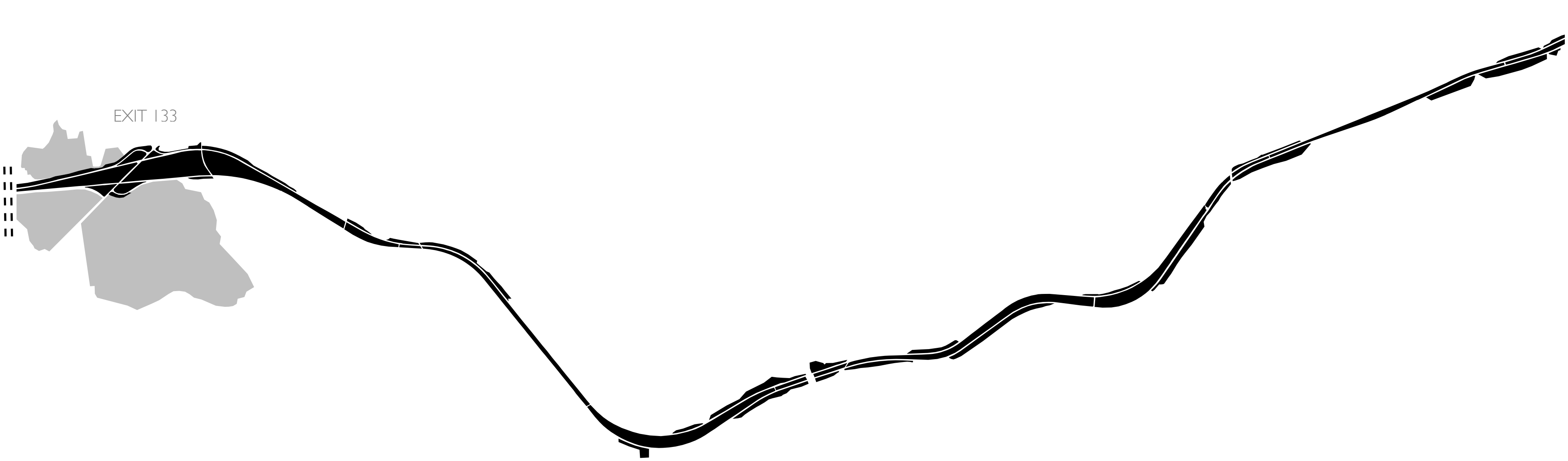


1 ACRE ▪ 5 ACRES ■ 1 MILE ⊢——⊣ CORRIDOR SITE ADJACENT SITE

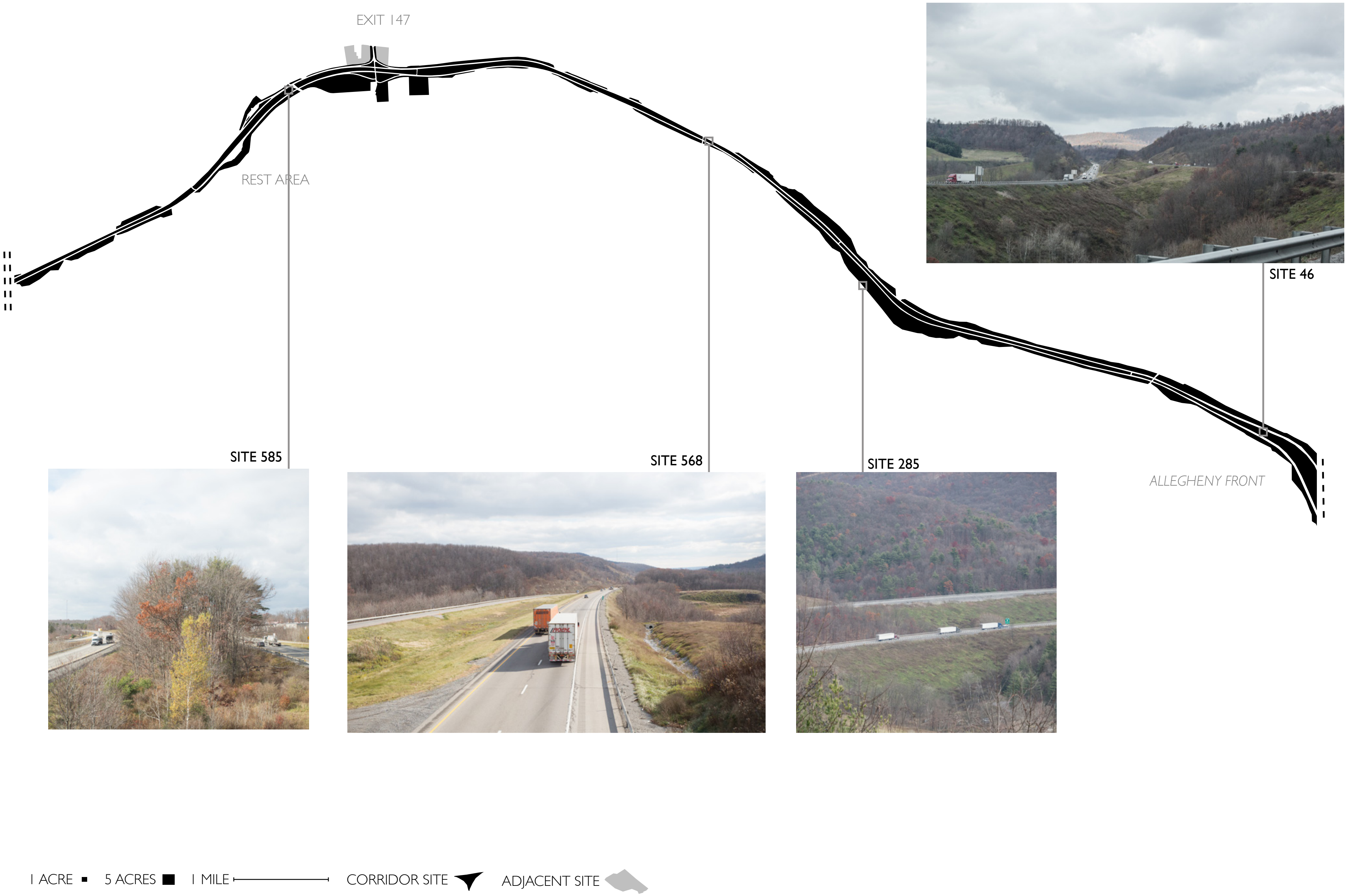

EXIT 111
EXIT 120
WEST BRANCH SUSQUEHANNA RIVER
1 ACRE
5 ACRES
1 MILE
CORRIDOR SITE
ADJACENT SITE

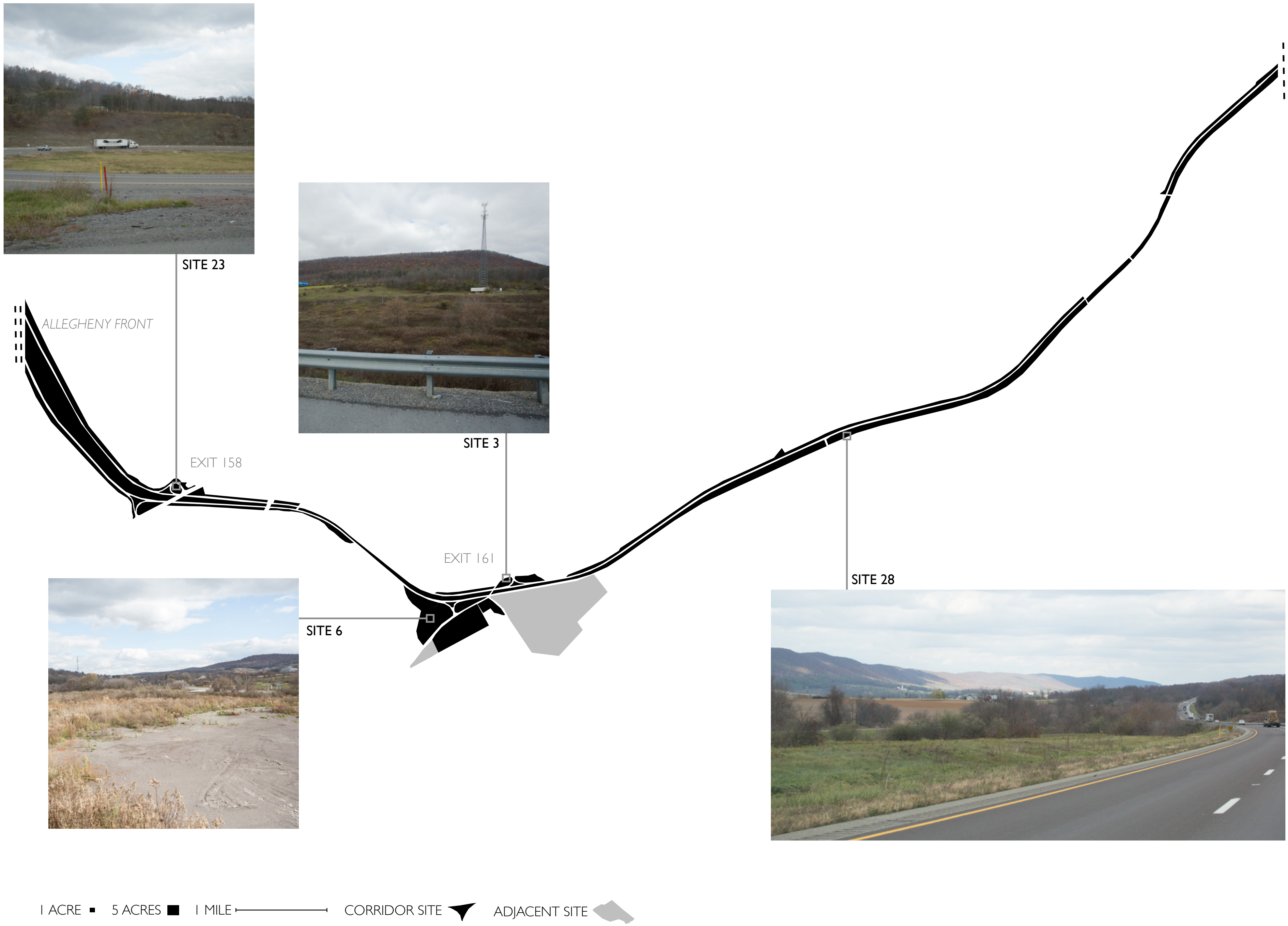

ABANDONED
BITUMINOUS
STRIP MINES
EXIT 123

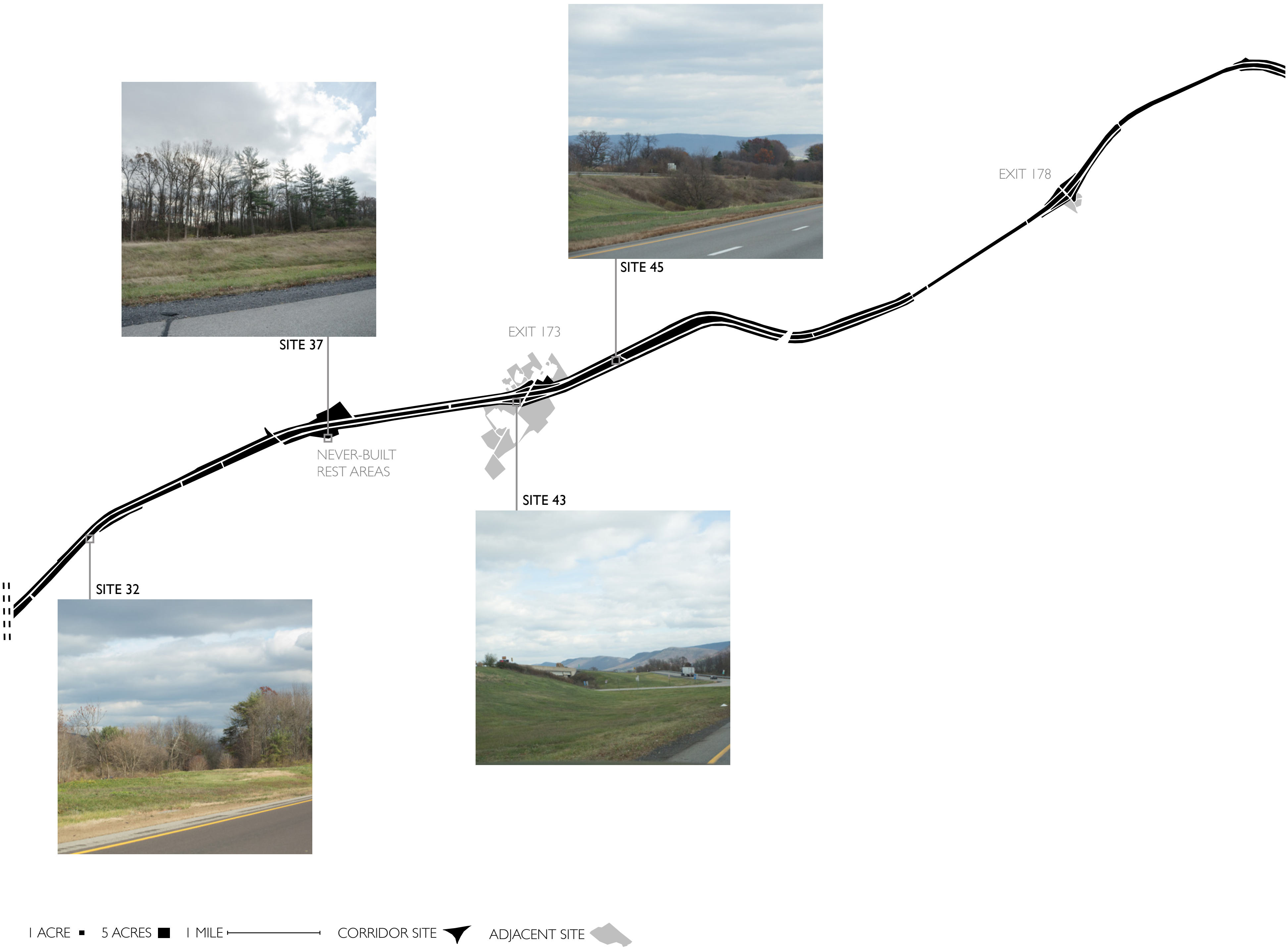

1 ACRE
5 ACRES
1 MILE
CORRIDOR SITE
ADJACENT SITE

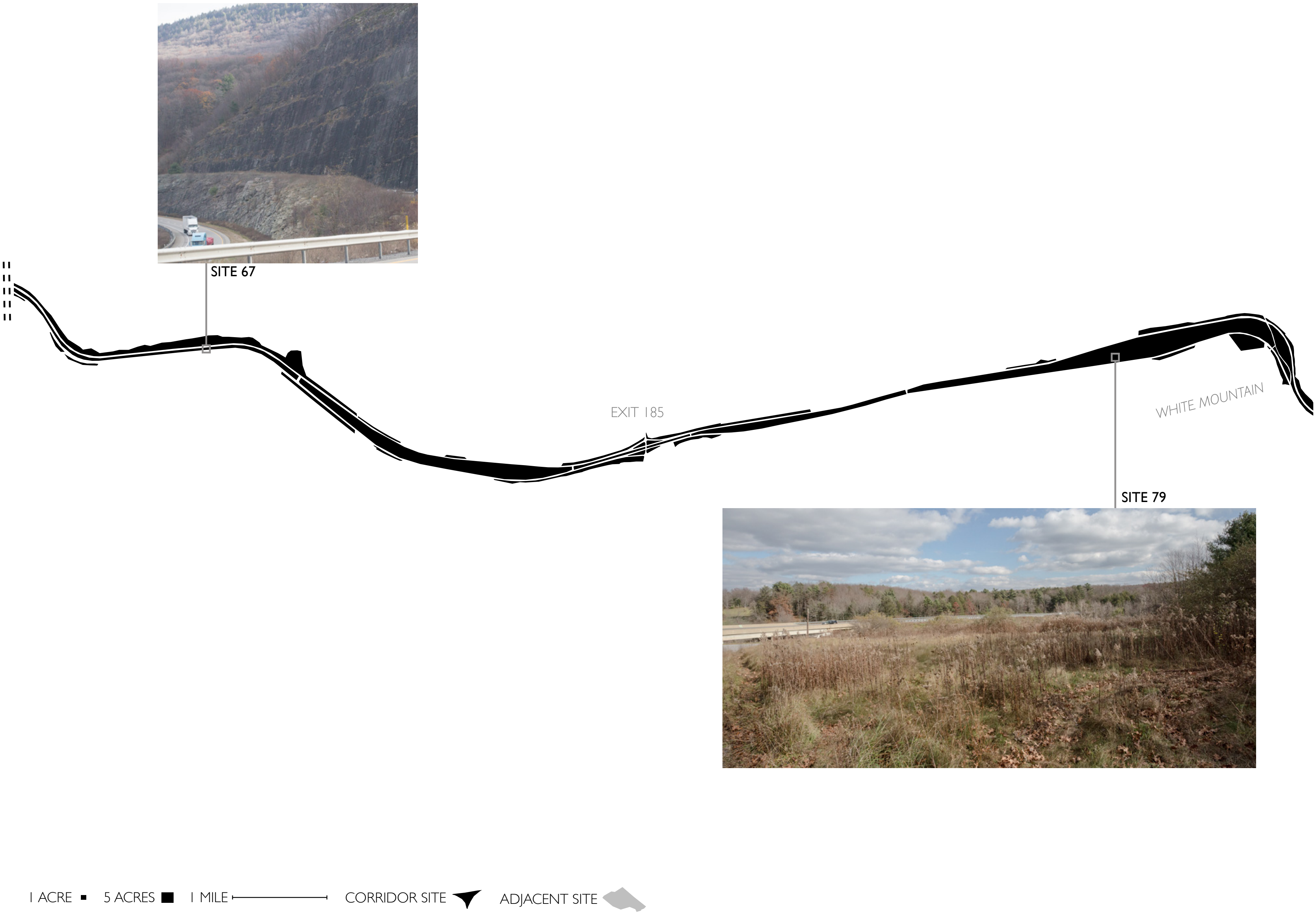


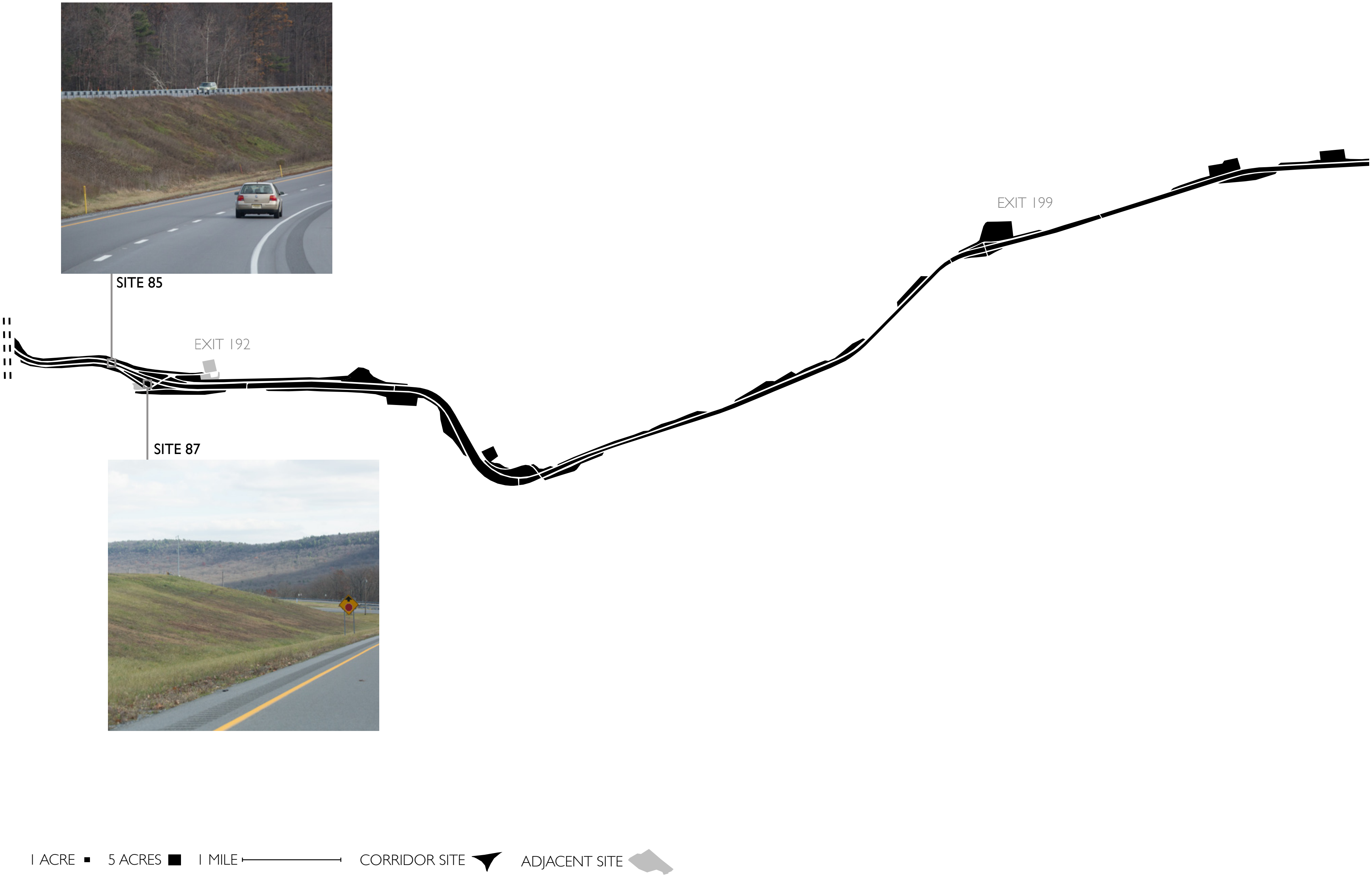
I ACRE ▪ 5 ACRES ■ I MILE ⊢—⊣ CORRIDOR SITE ADJACENT SITE

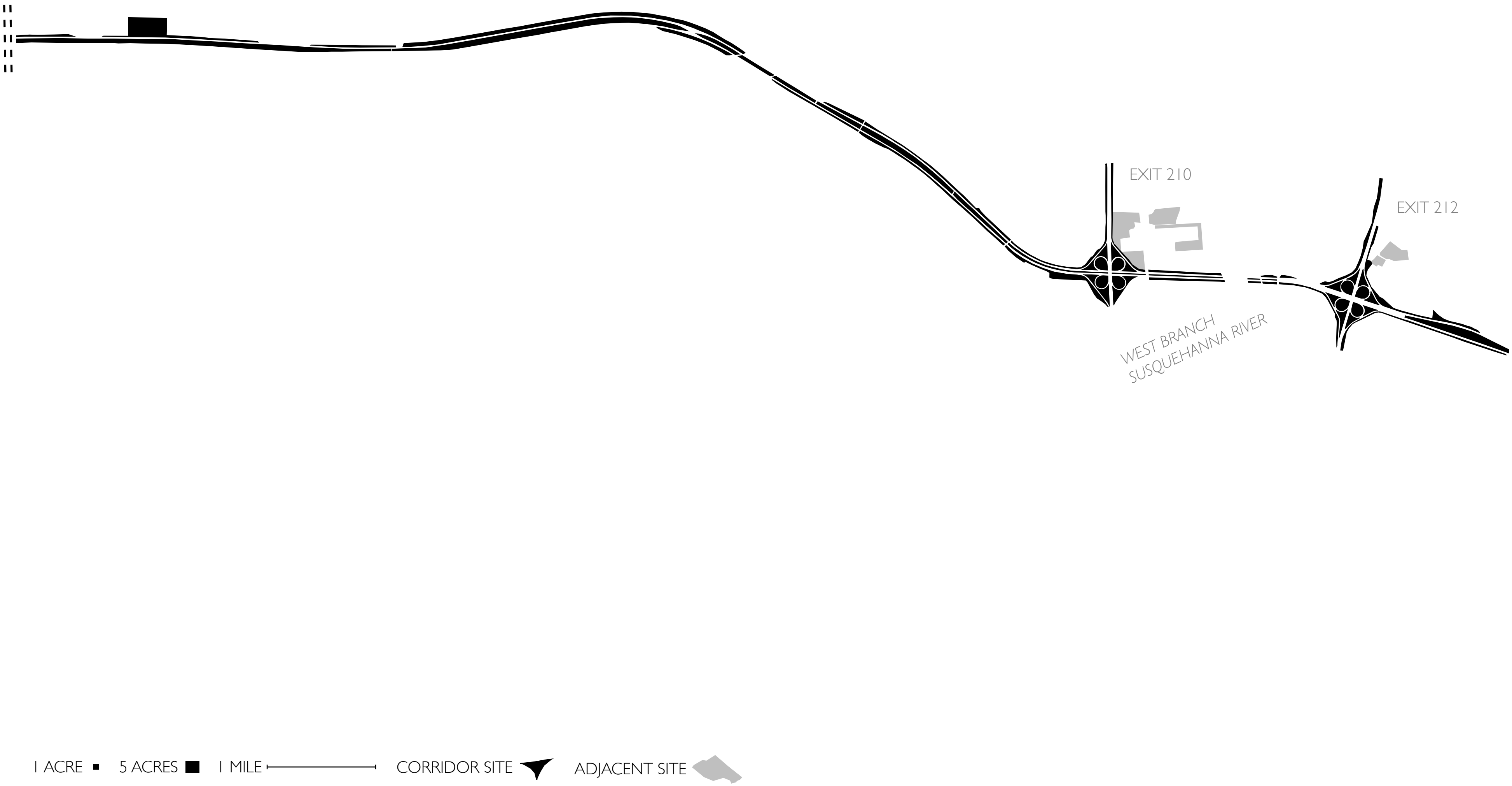

EXIT 147
REST AREA
SITE 46
SITE 585
SITE 568
SITE 285
ALLEGHENY FRONT
1 ACRE
5 ACRES
1 MILE
CORRIDOR SITE
ADJACENT SITE

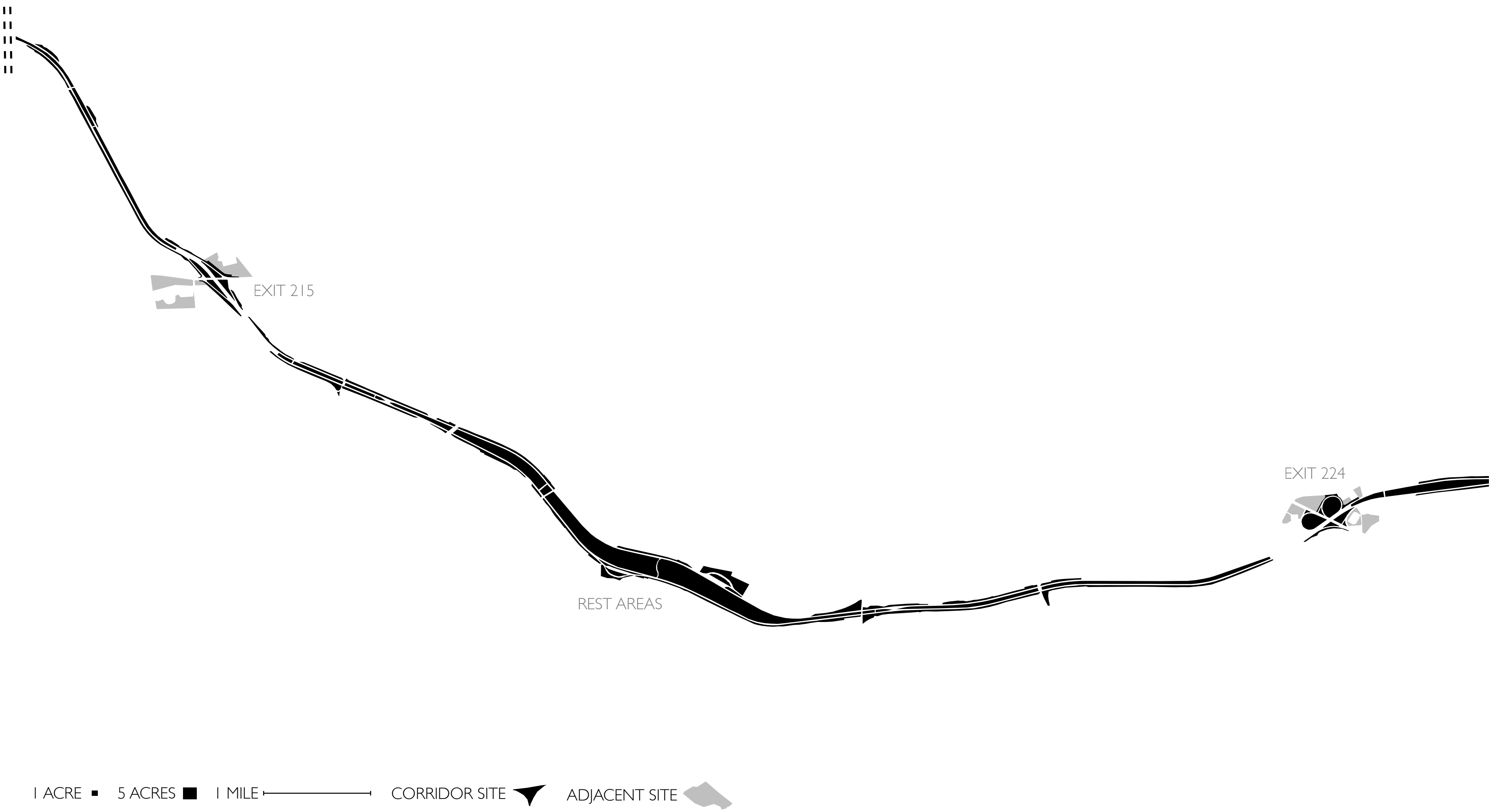

SITE 23
ALLEGHENY FRONT
EXIT 158
SITE 3
EXIT 161
SITE 6
SITE 28
1 ACRE
5 ACRES
1 MILE
CORRIDOR SITE
ADJACENT SITE

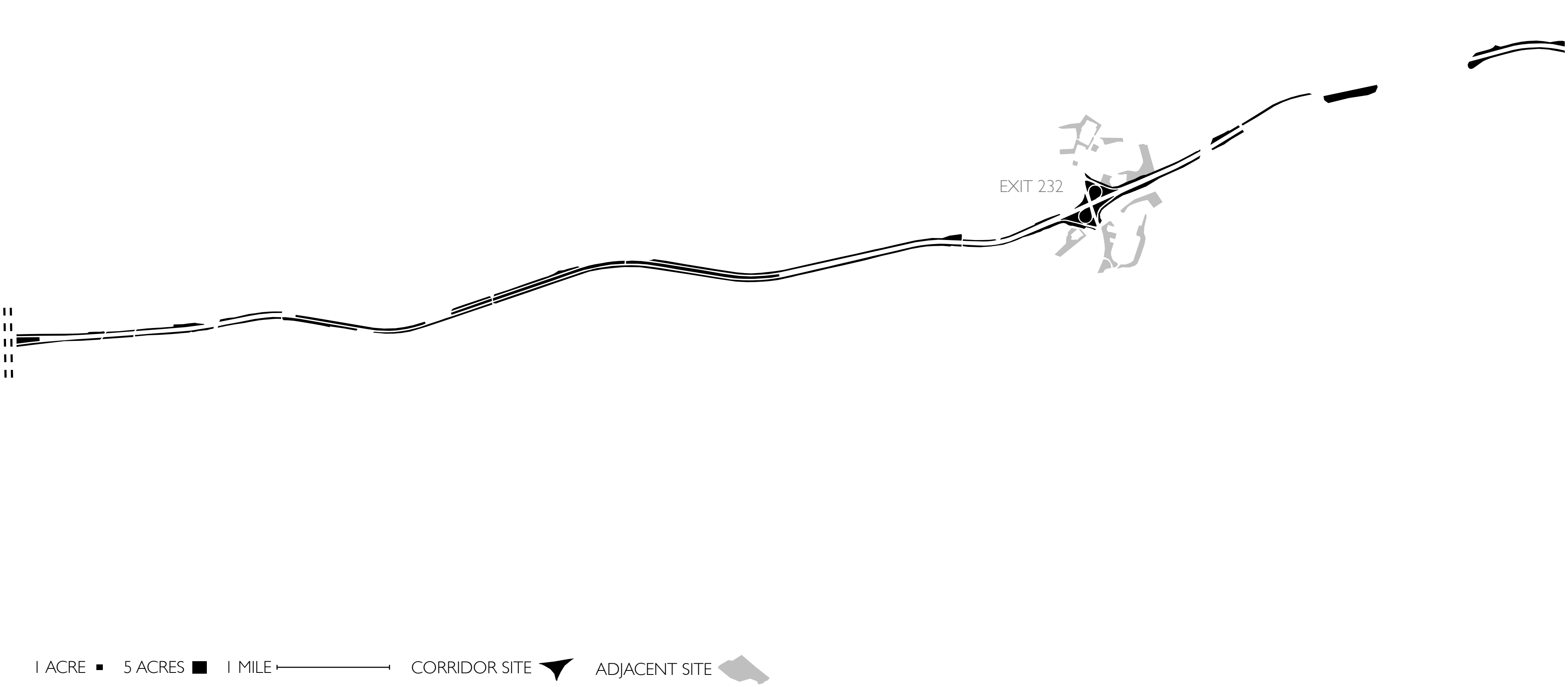

SITE 37
SITE 45
EXIT 173
EXIT 178
NEVER-BUILT
REST AREAS
SITE 43
SITE 32
1 ACRE
5 ACRES
1 MILE
CORRIDOR SITE
ADJACENT SITE

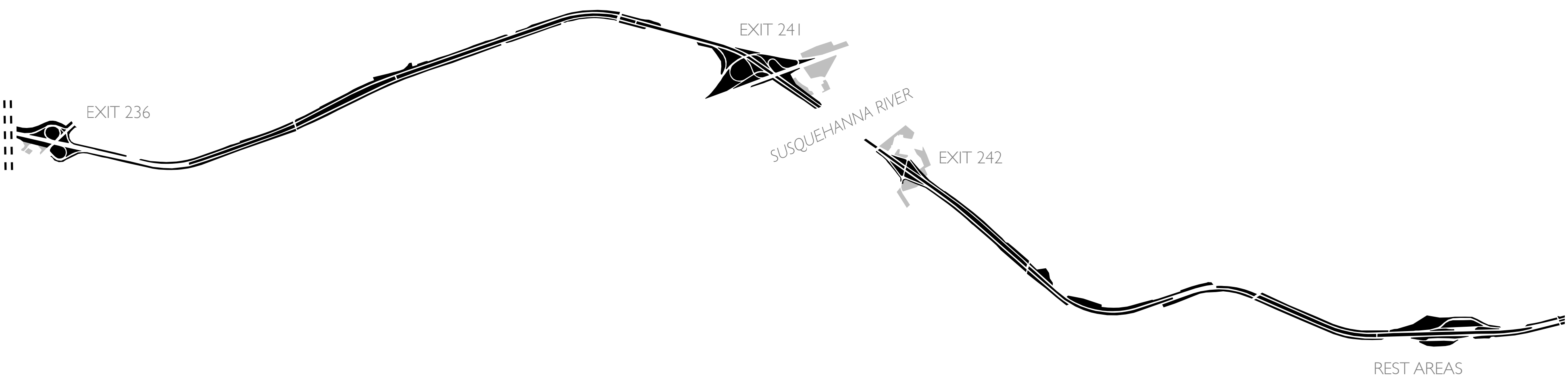

SITE 67
EXIT 185
WHITE MOUNTAIN
SITE 79
1 ACRE
5 ACRES
1 MILE
CORRIDOR SITE
ADJACENT SITE


SITE 85
EXIT 192
SITE 87
EXIT 199
1 ACRE
5 ACRES
1 MILE
CORRIDOR SITE
ADJACENT SITE


EXIT 210
EXIT 212
WEST BRANCH
SUSQUEHANNA RIVER
1 ACRE
5 ACRES
1 MILE
CORRIDOR SITE
ADJACENT SITE

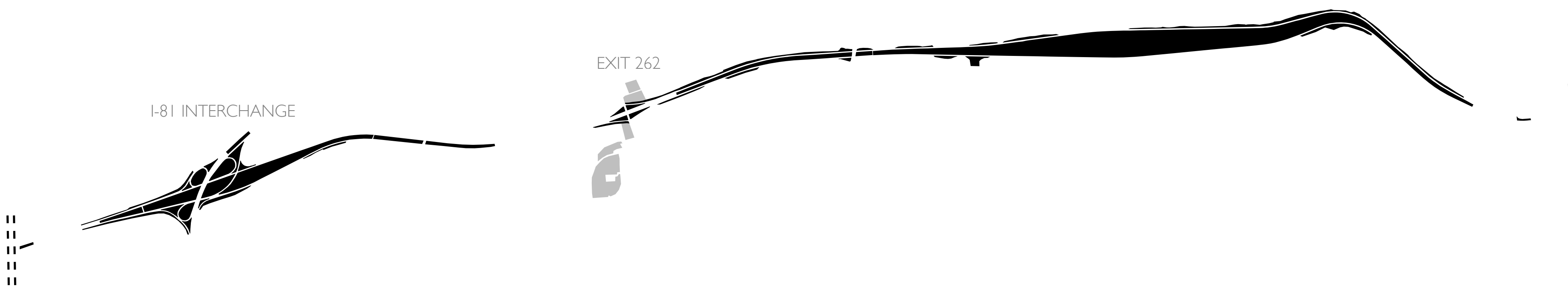

EXIT 215
REST AREAS
EXIT 224
1 ACRE
5 ACRES
1 MILE
CORRIDOR SITE
ADJACENT SITE


EXIT 232
1 ACRE
5 ACRES
1 MILE
CORRIDOR SITE
ADJACENT SITE

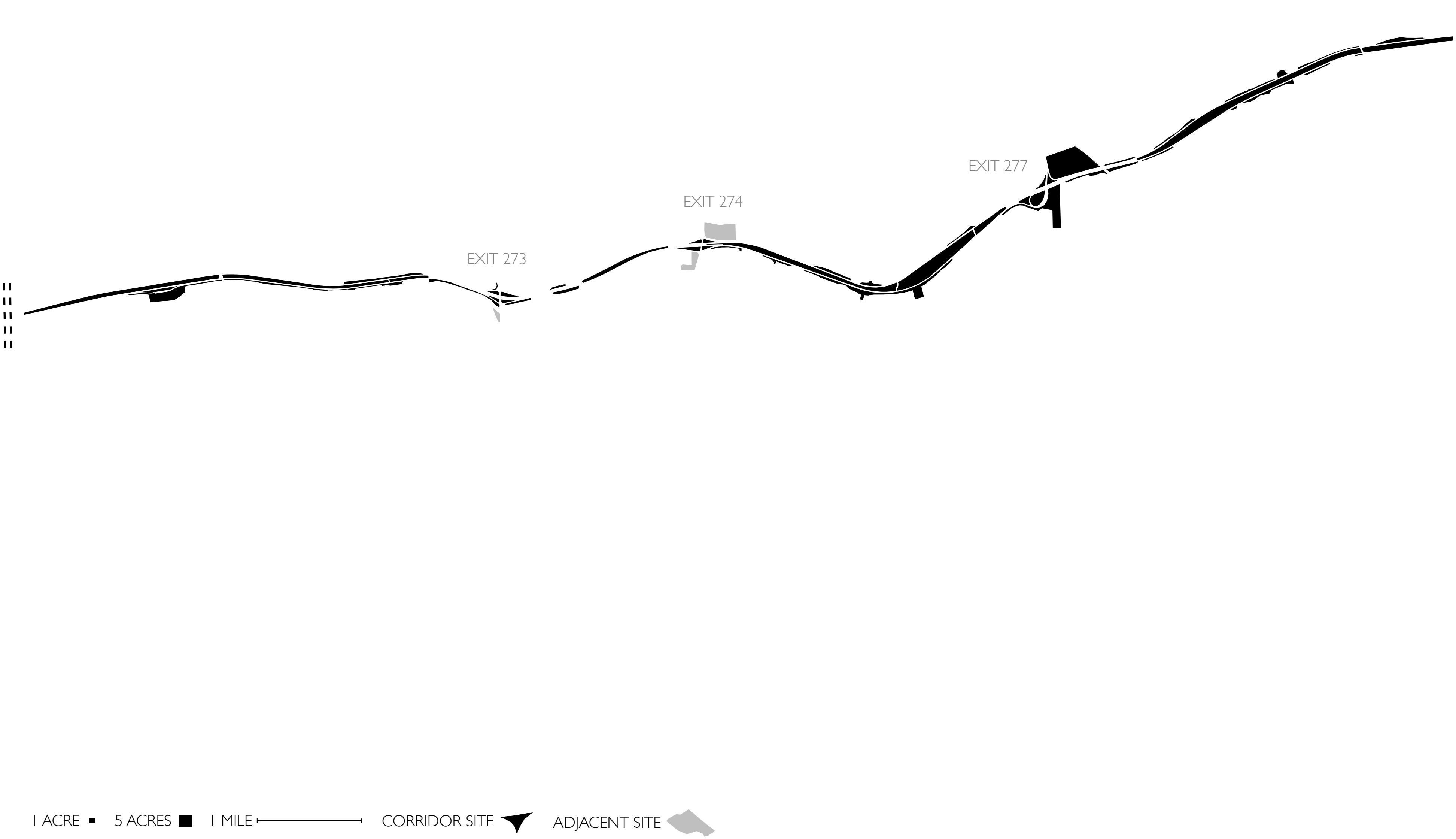


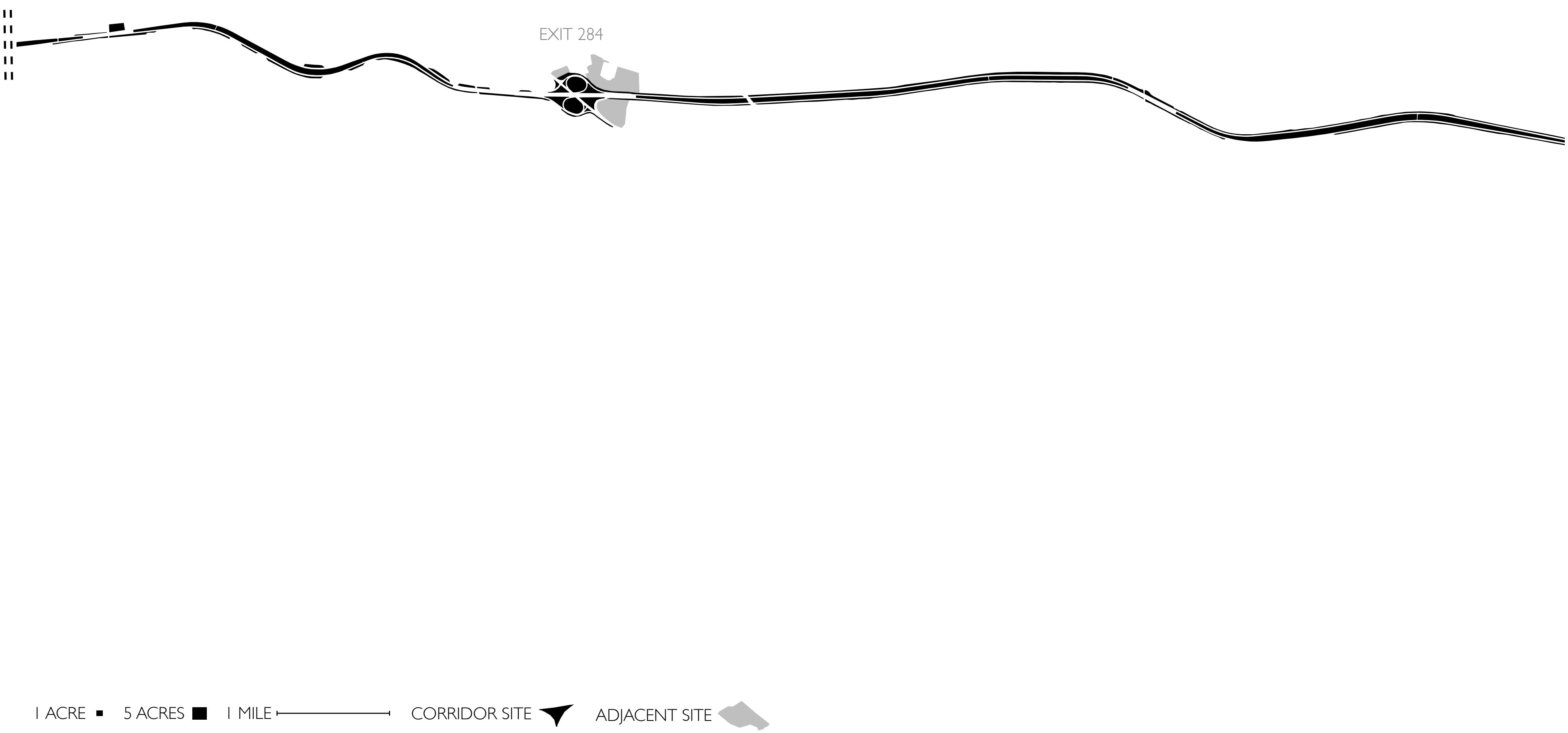
1 ACRE ▪ 5 ACRES ■ 1 MILE —— CORRIDOR SITE ADJACENT SITE

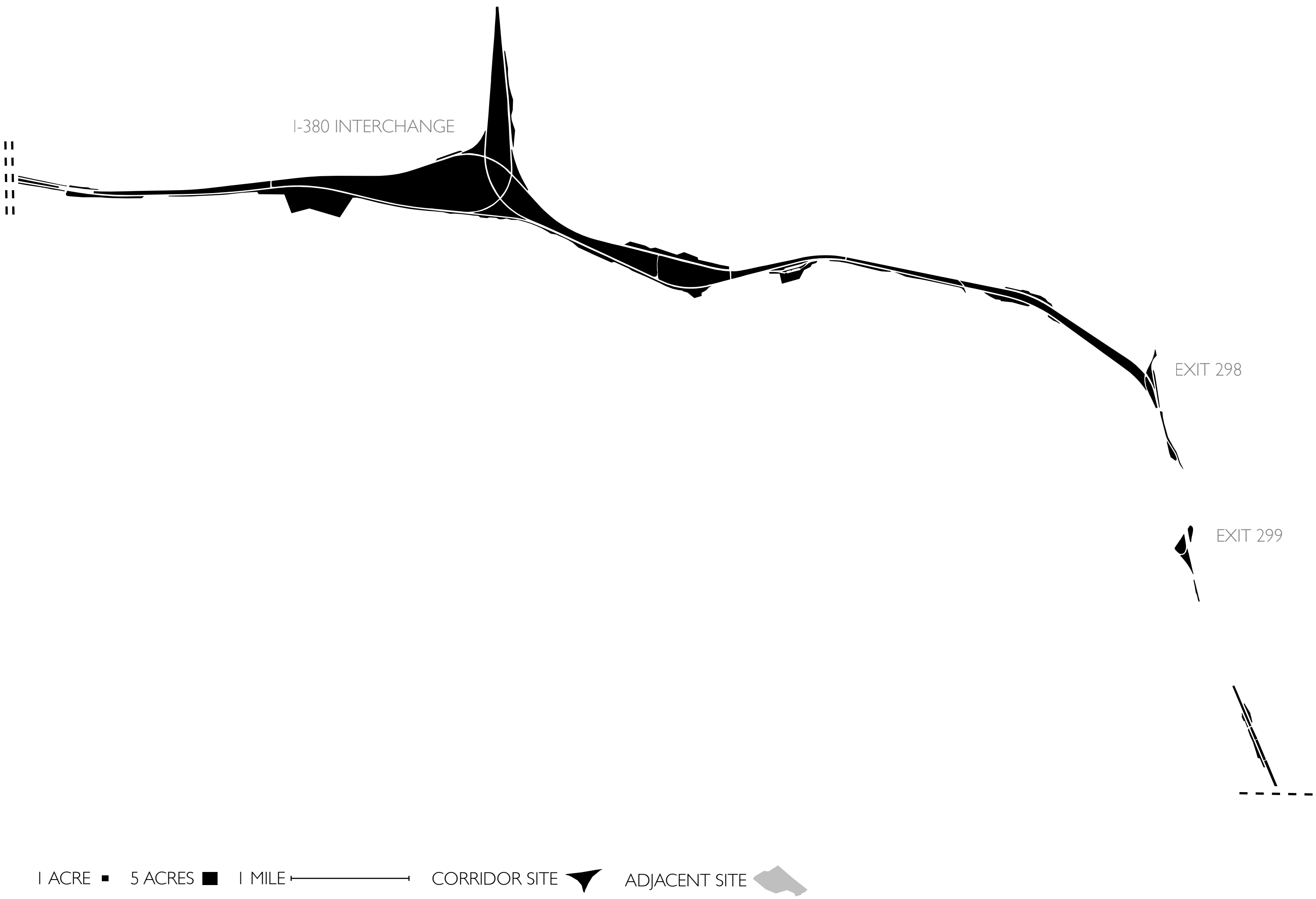

EXIT 256
NESCOPECK MOUNTAIN
1 ACRE
5 ACRES
1 MILE
CORRIDOR SITE
ADJACENT SITE



1 ACRE ▪ 5 ACRES ■ 1 MILE CORRIDOR SITE ADJACENT SITE


EXIT 273
EXIT 274
EXIT 277
1 ACRE
5 ACRES
1 MILE
CORRIDOR SITE
ADJACENT SITE


EXIT 284
1 ACRE
5 ACRES
1 MILE
CORRIDOR SITE
ADJACENT SITE


I-380 INTERCHANGE
EXIT 298
EXIT 299
1 ACRE
5 ACRES
1 MILE
CORRIDOR SITE
ADJACENT SITE


EXIT 302
EXIT 303
EXIT 305
EXIT 307
EXIT 308
EXIT 309
EXIT 310
NEW JERSEY BORDER
DELAWARE RIVER
1 ACRE
5 ACRES
1 MILE
CORRIDOR SITE
ADJACENT SITE

Appendix B:
Norfolk Southern Eastern Division Linear Site Catalog

Sites along Norfolk Southern Eastern Division are presented in a figure-ground diagram as the sites exist along the length of the corridor. A single dashed line indicates that the corridor continues on the next page; a double dashed line indicates where the corridor continues on that page.

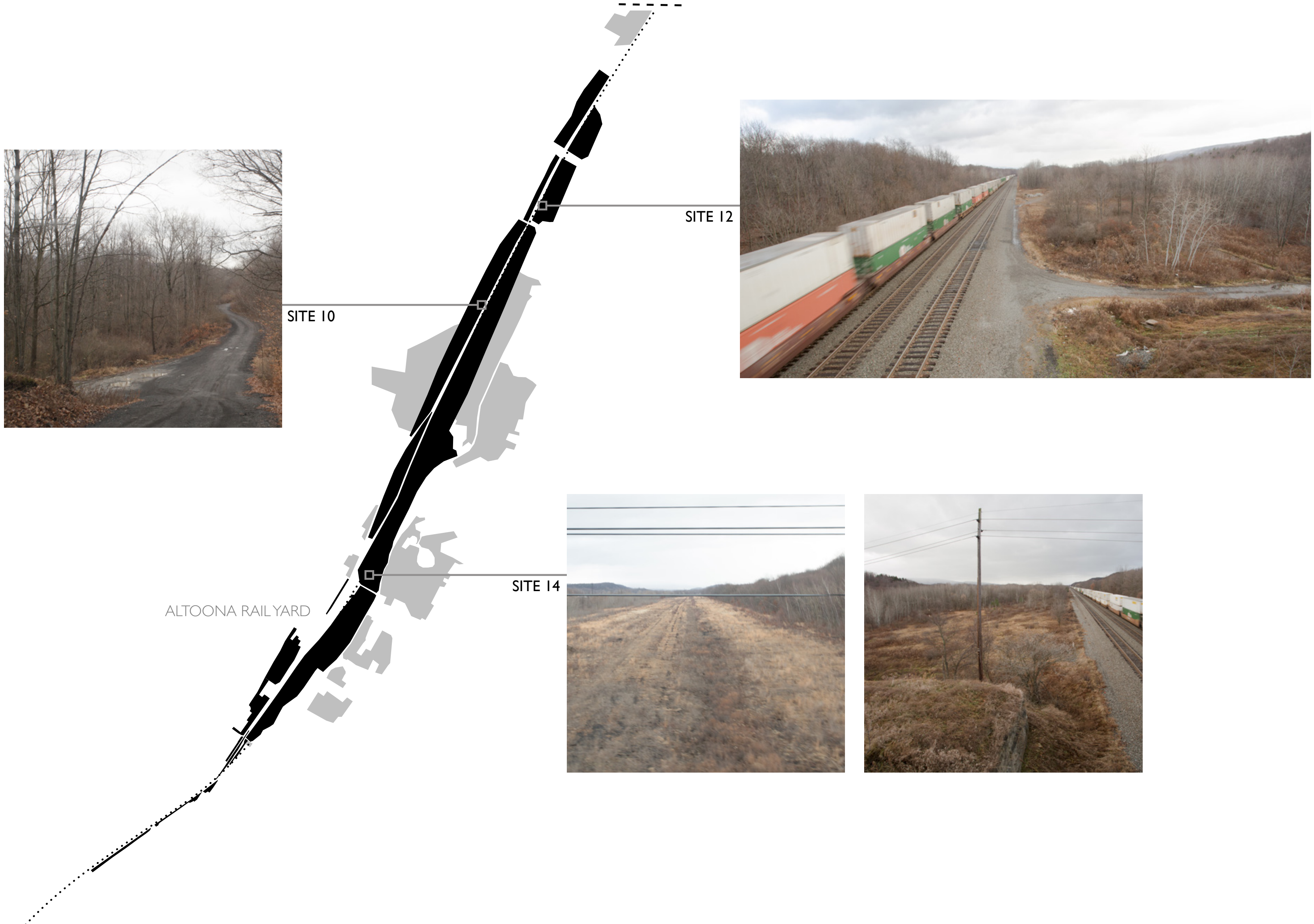
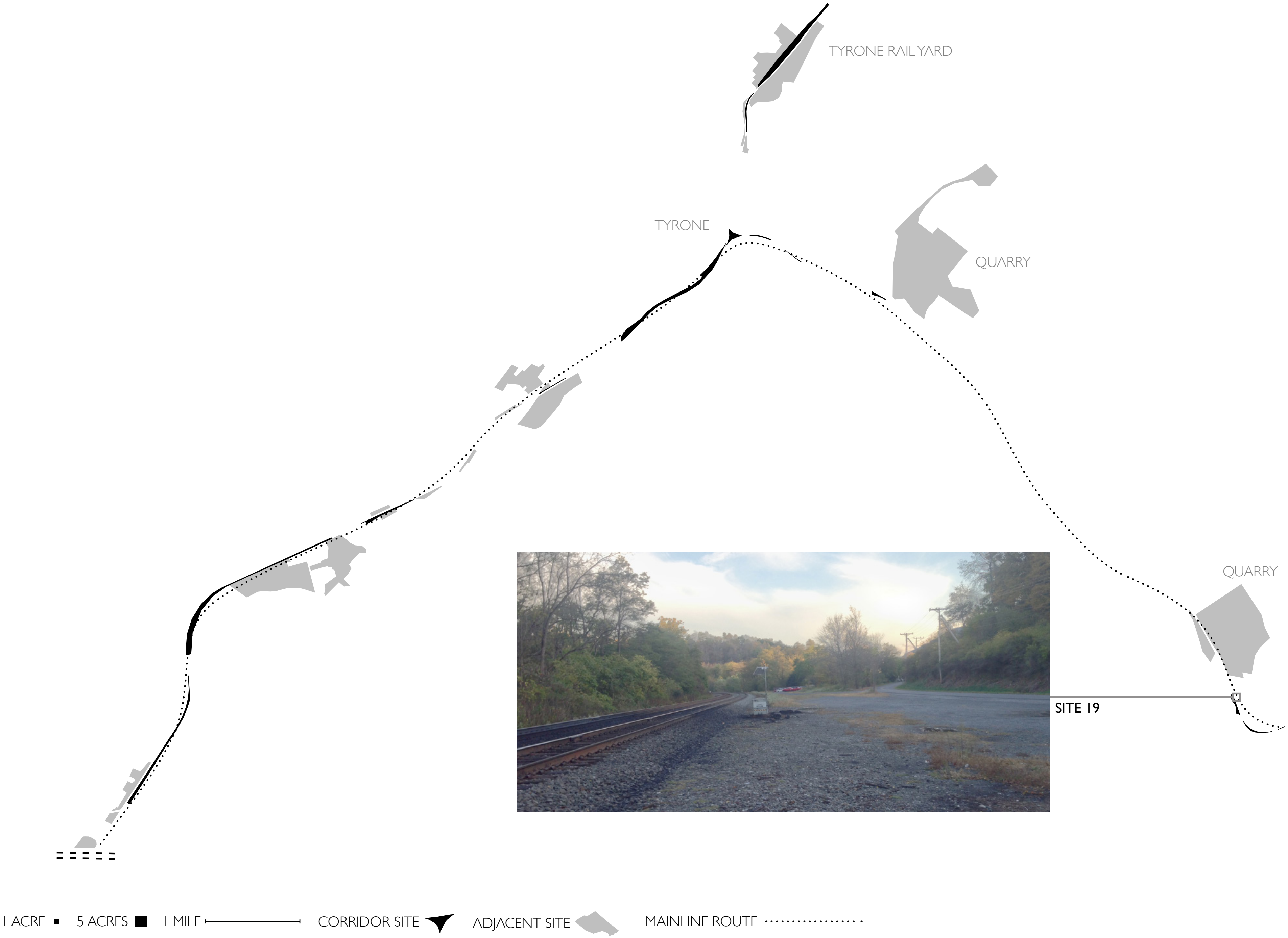
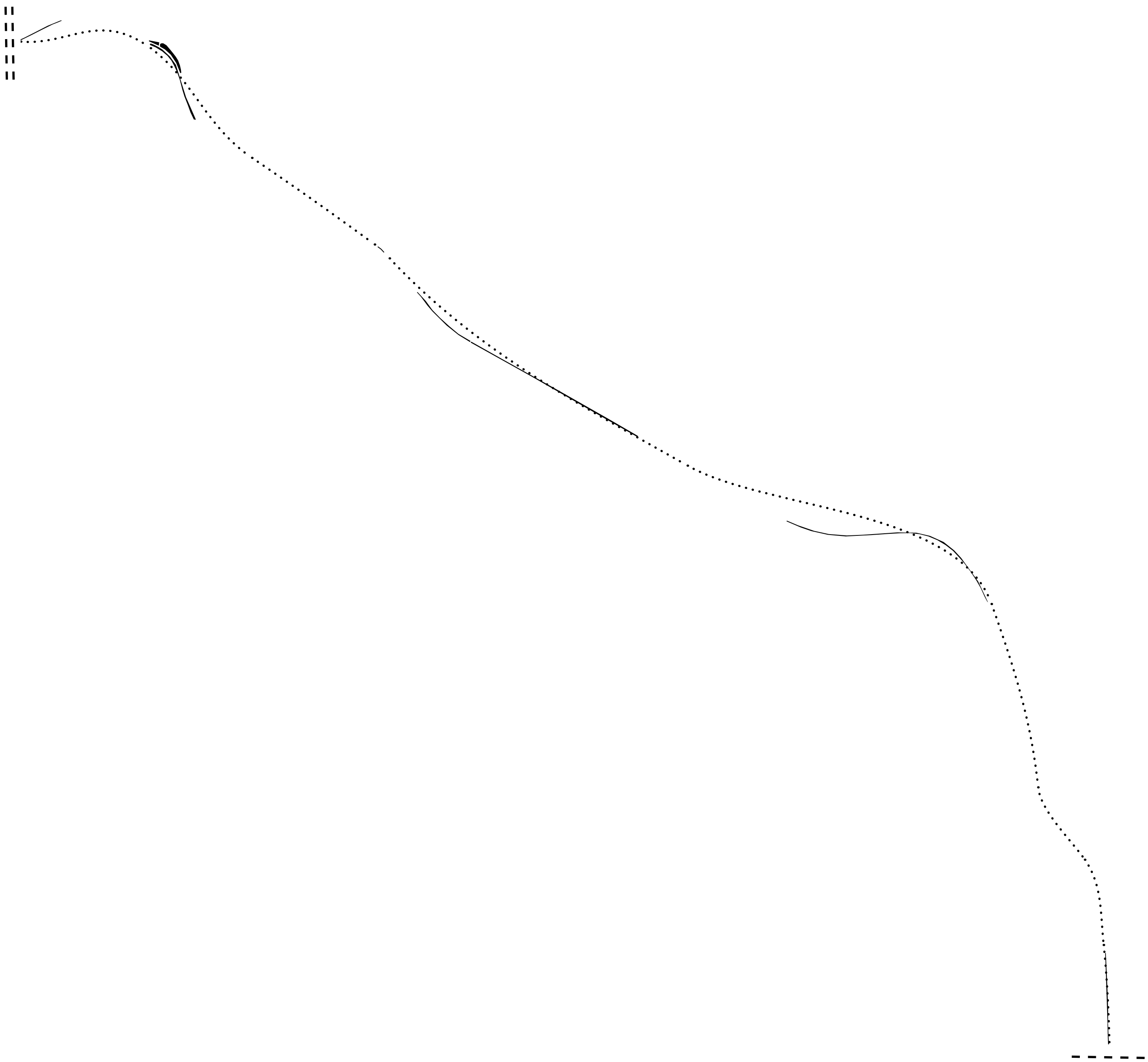


Figure 93 Norfolk Southern Railway Eastern Division Linear Site Catalog

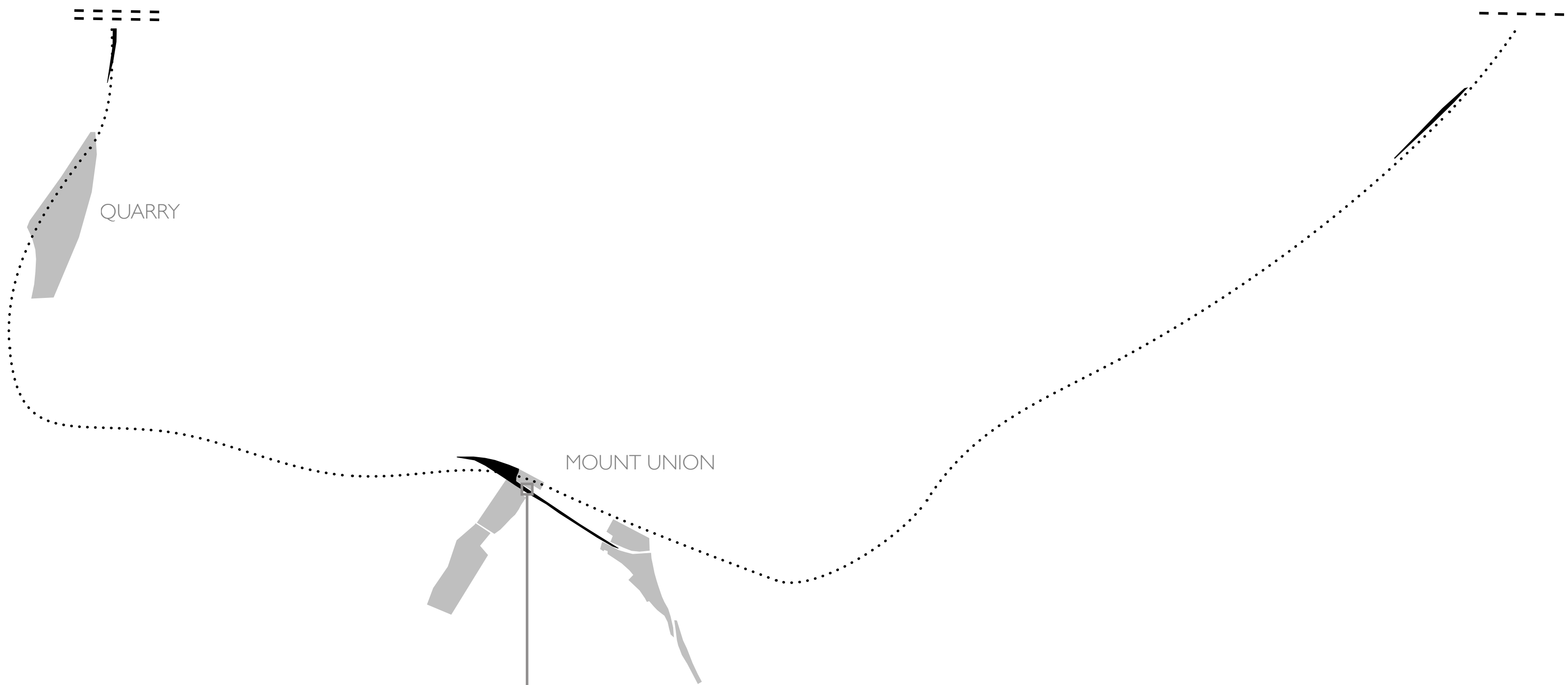
1 ACRE 5 ACRES 1 MILE CORRIDOR SITE ADJACENT SITE MAINLINE ROUTE


TYRONE RAIL YARD
TYRONE
QUARRY
QUARRY
SITE 19
1 ACRE
5 ACRES
1 MILE
CORRIDOR SITE
ADJACENT SITE
MAINLINE ROUTE



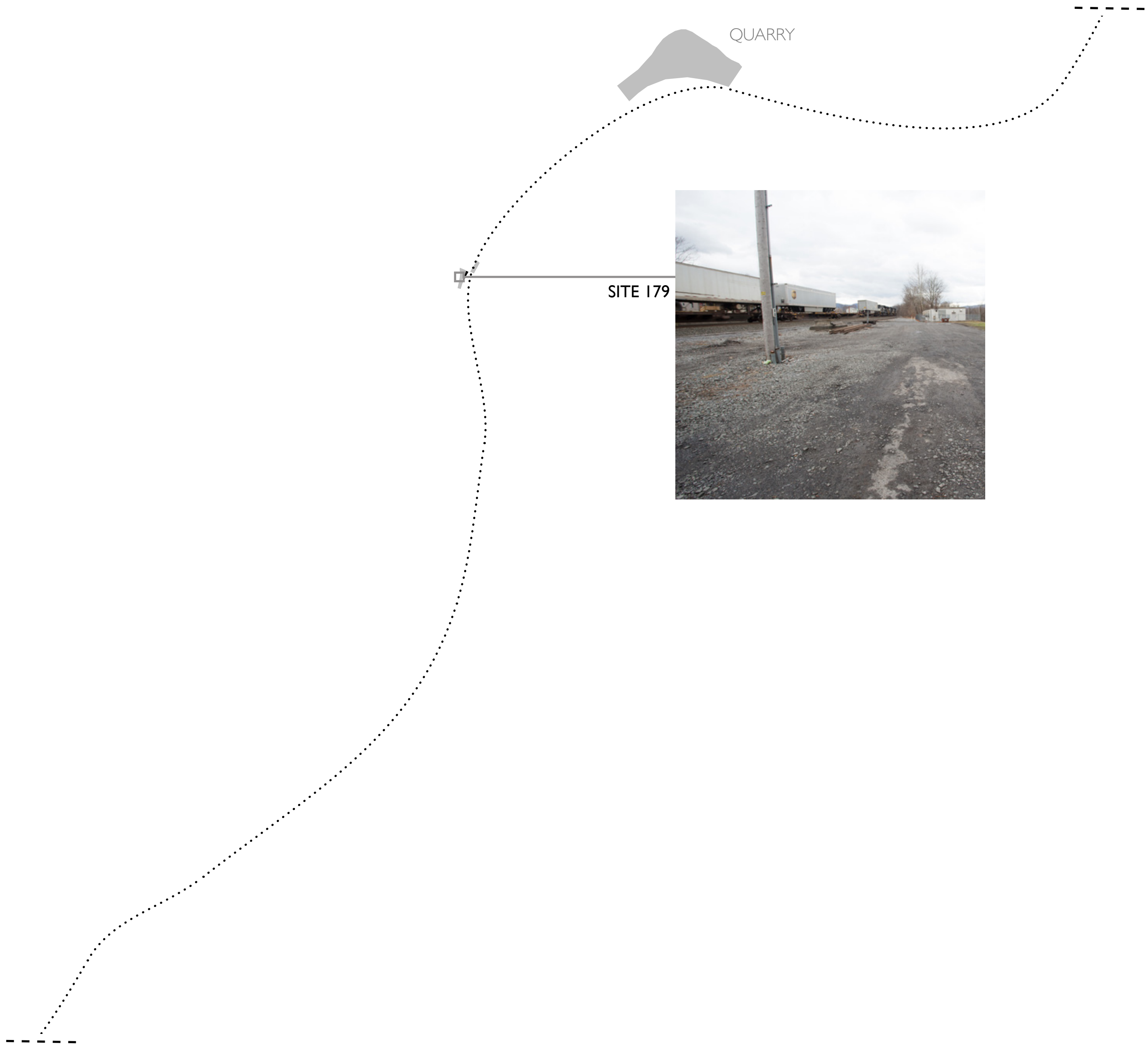
1 ACRE ▪ 5 ACRES ■ 1 MILE CORRIDOR SITE ADJACENT SITE MAINLINE ROUTE

I ACRE ▪ 5 ACRES ■ I MILE ⊢——⊣ CORRIDOR SITE ADJACENT SITE MAINLINE ROUTE ··············

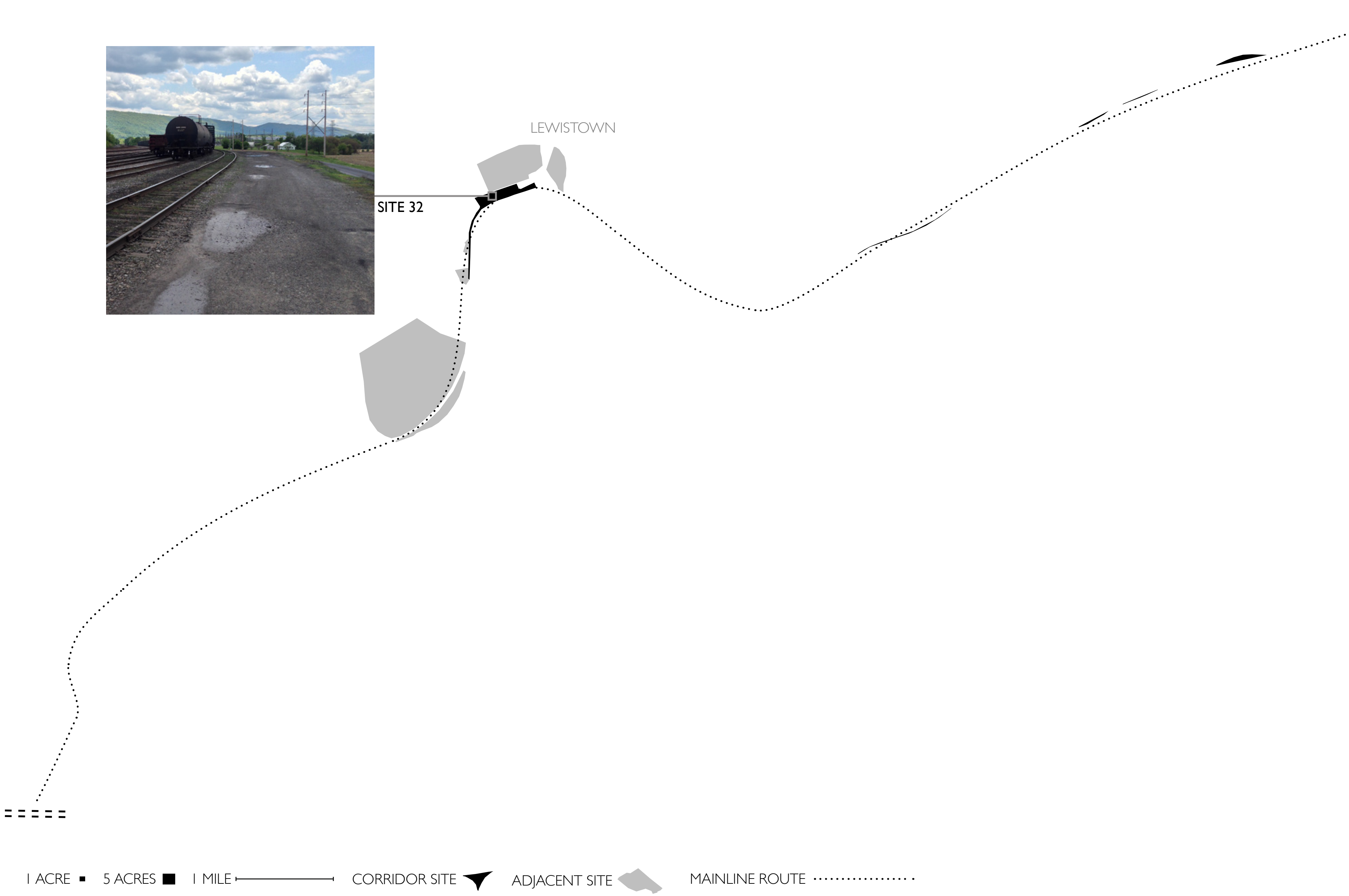


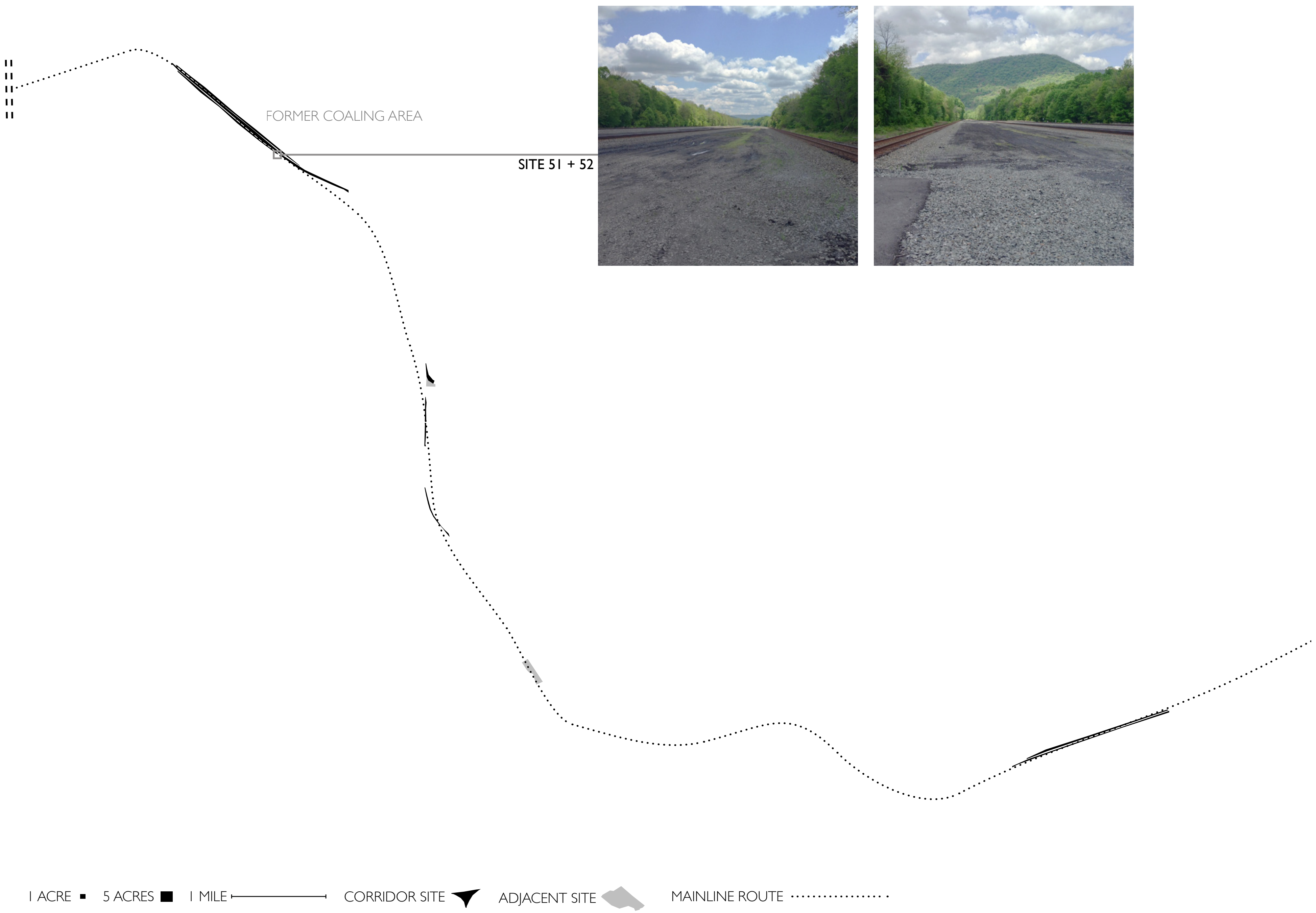
SITE 29

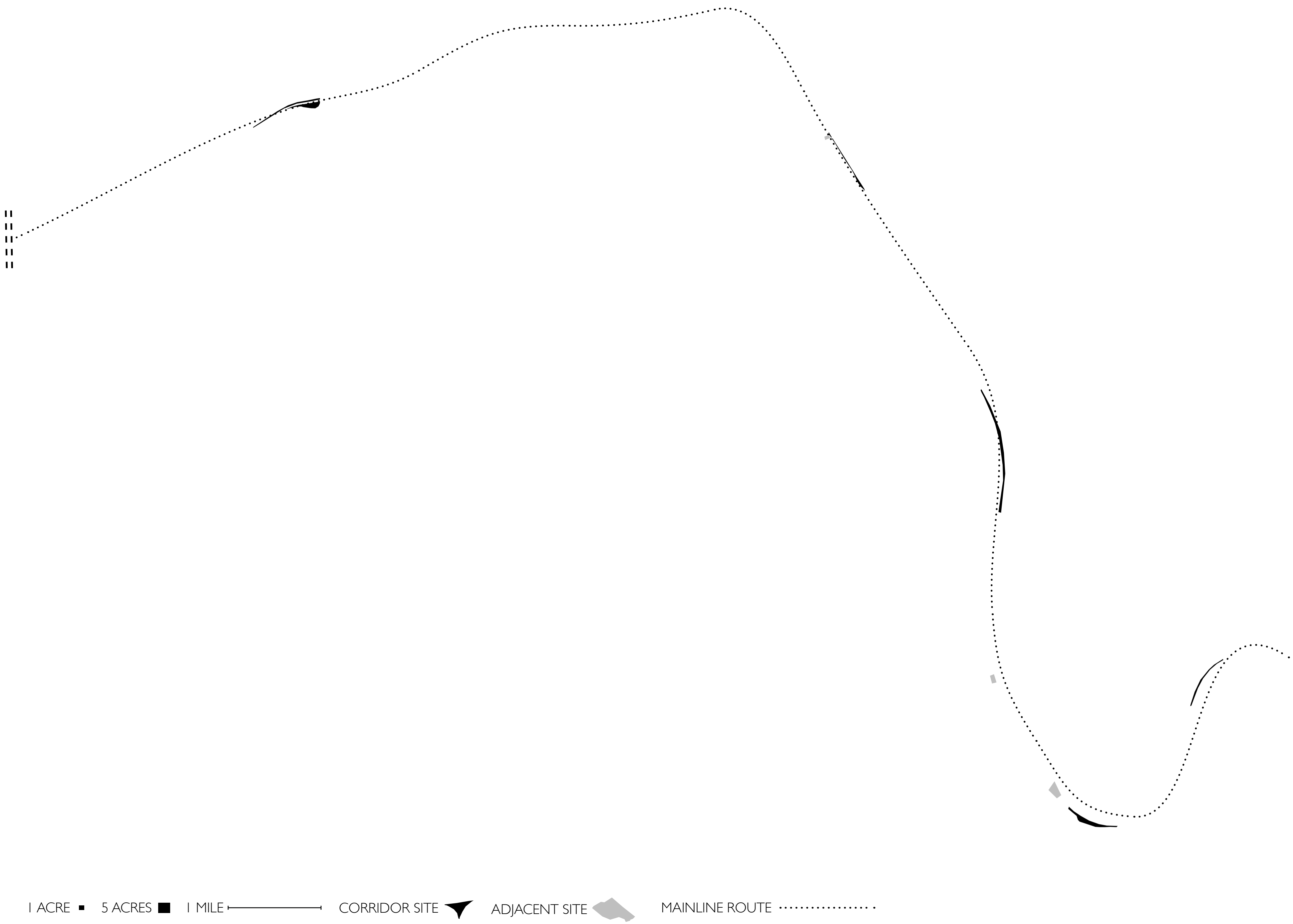
I ACRE ▪ 5 ACRES ■ I MILE ├────┤ CORRIDOR SITE ADJACENT SITE MAINLINE ROUTE ··············

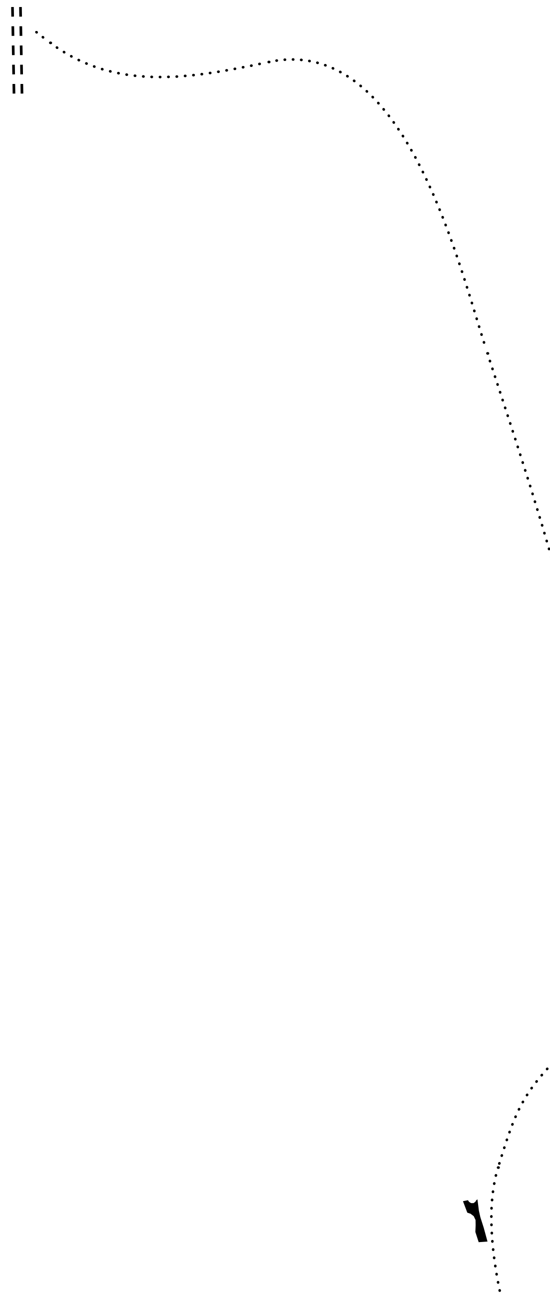


1 ACRE ▪ 5 ACRES ■ 1 MILE — CORRIDOR SITE ADJACENT SITE MAINLINE ROUTE ···············


LEWISTOWN
SITE 32
1 ACRE
5 ACRES
1 MILE
CORRIDOR SITE
ADJACENT SITE
MAINLINE ROUTE


FORMER COALING AREA
SITE 51 + 52
1 ACRE
5 ACRES
1 MILE
CORRIDOR SITE
ADJACENT SITE
MAINLINE ROUTE

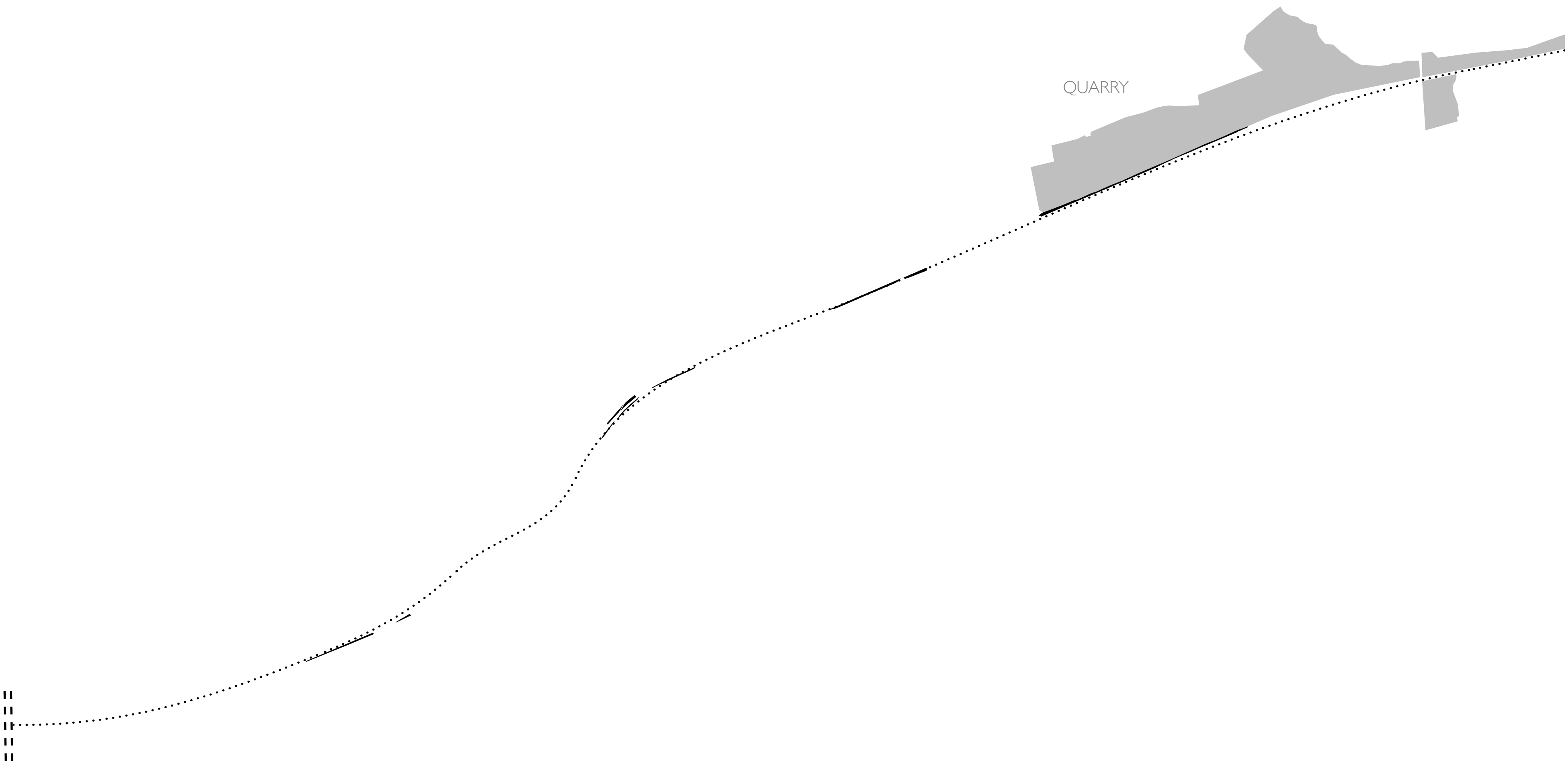

1 ACRE
5 ACRES
1 MILE
CORRIDOR SITE
ADJACENT SITE
MAINLINE ROUTE



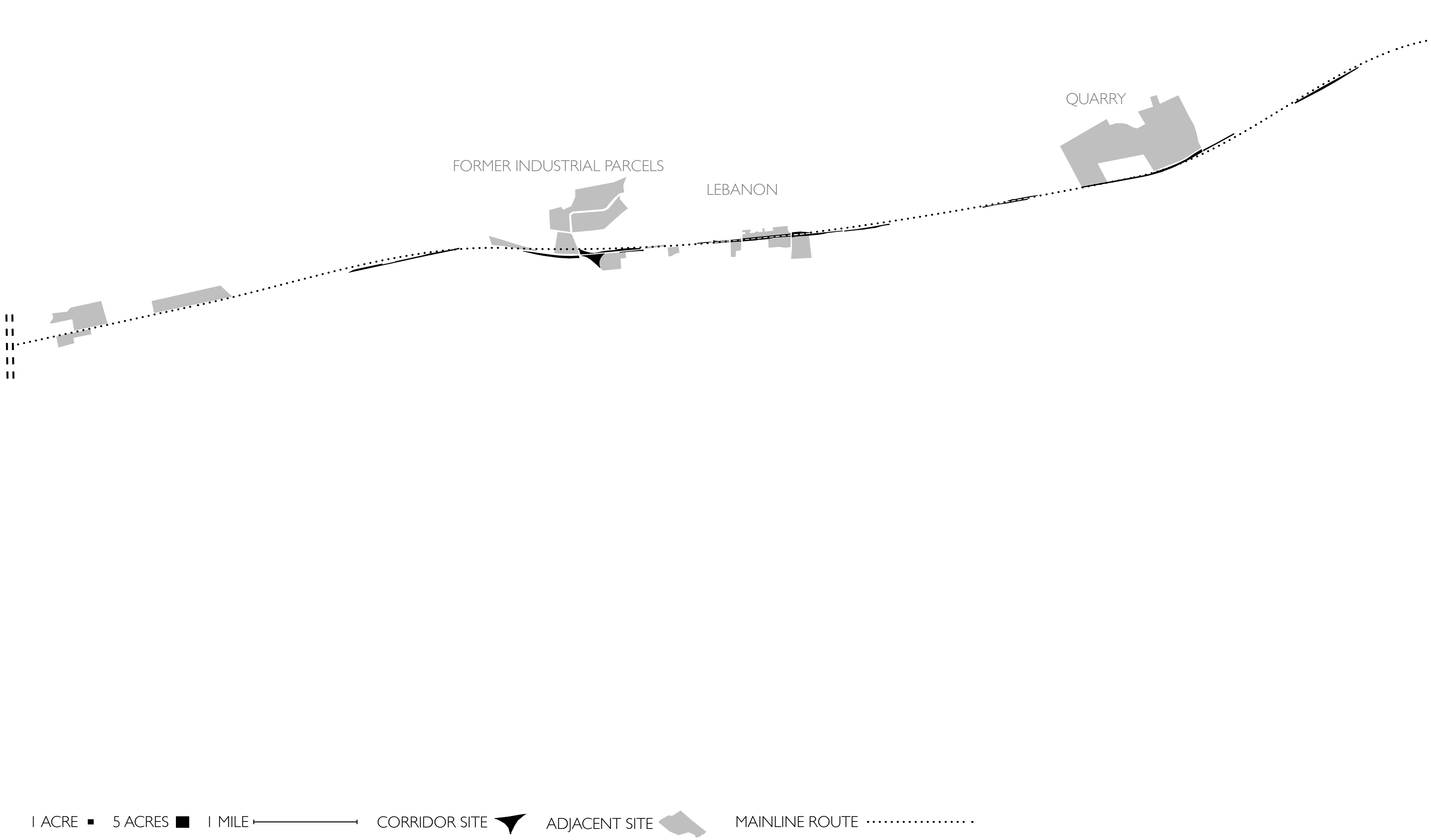
1 ACRE ▪ 5 ACRES ■ 1 MILE CORRIDOR SITE ADJACENT SITE MAINLINE ROUTE

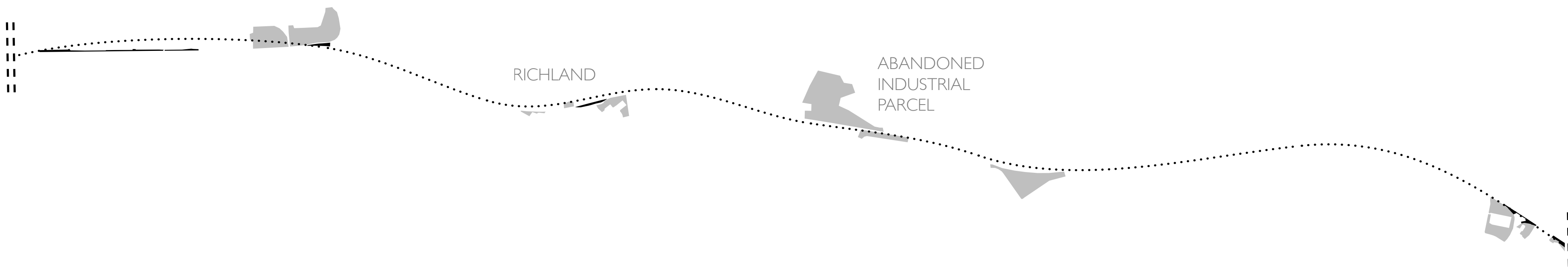
1 ACRE 5 ACRES 1 MILE CORRIDOR SITE ADJACENT SITE MAINLINE ROUTE

1 ACRE ▪ 5 ACRES ■ 1 MILE CORRIDOR SITE ADJACENT SITE MAINLINE ROUTE

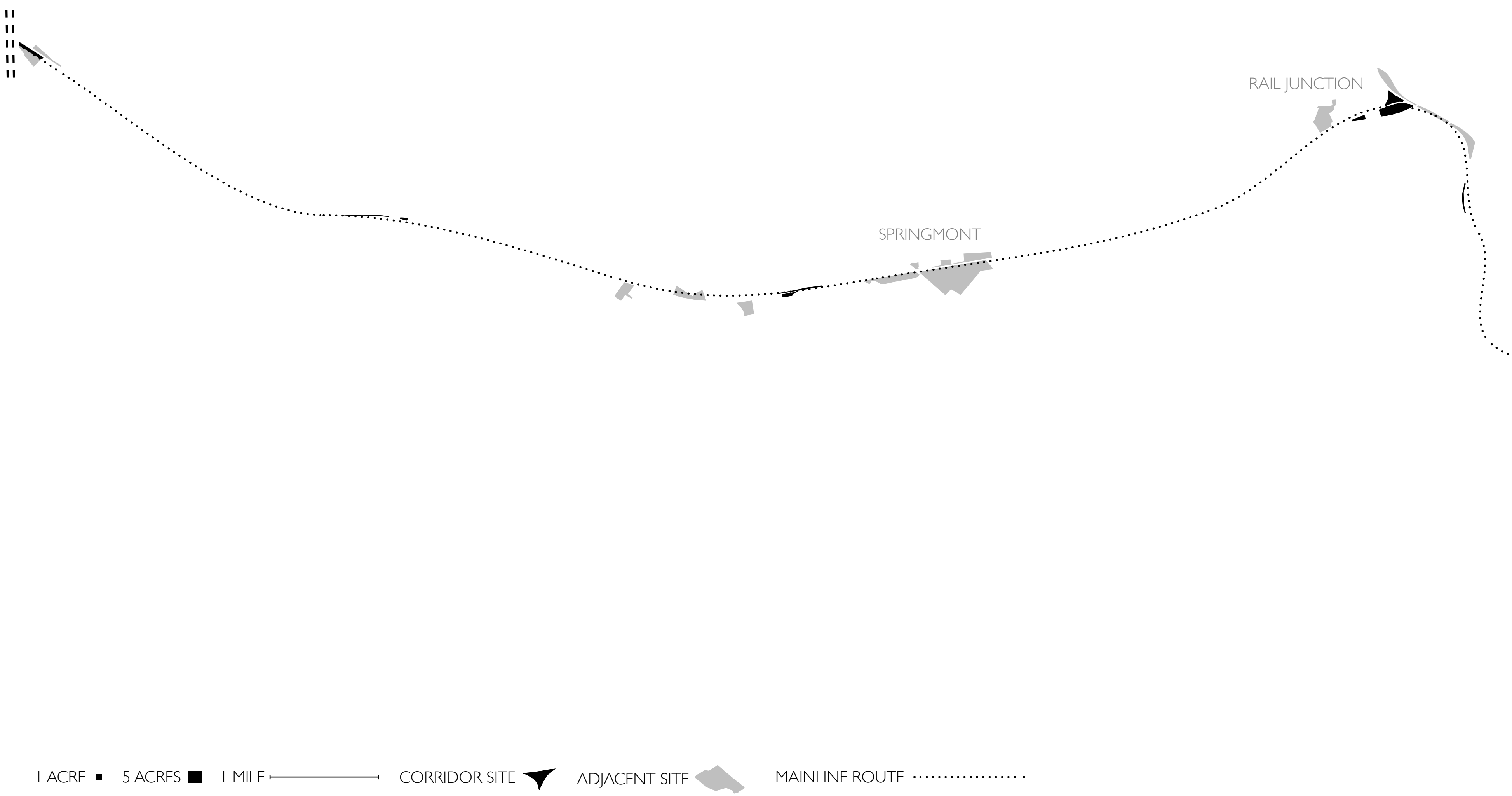

QUARRY

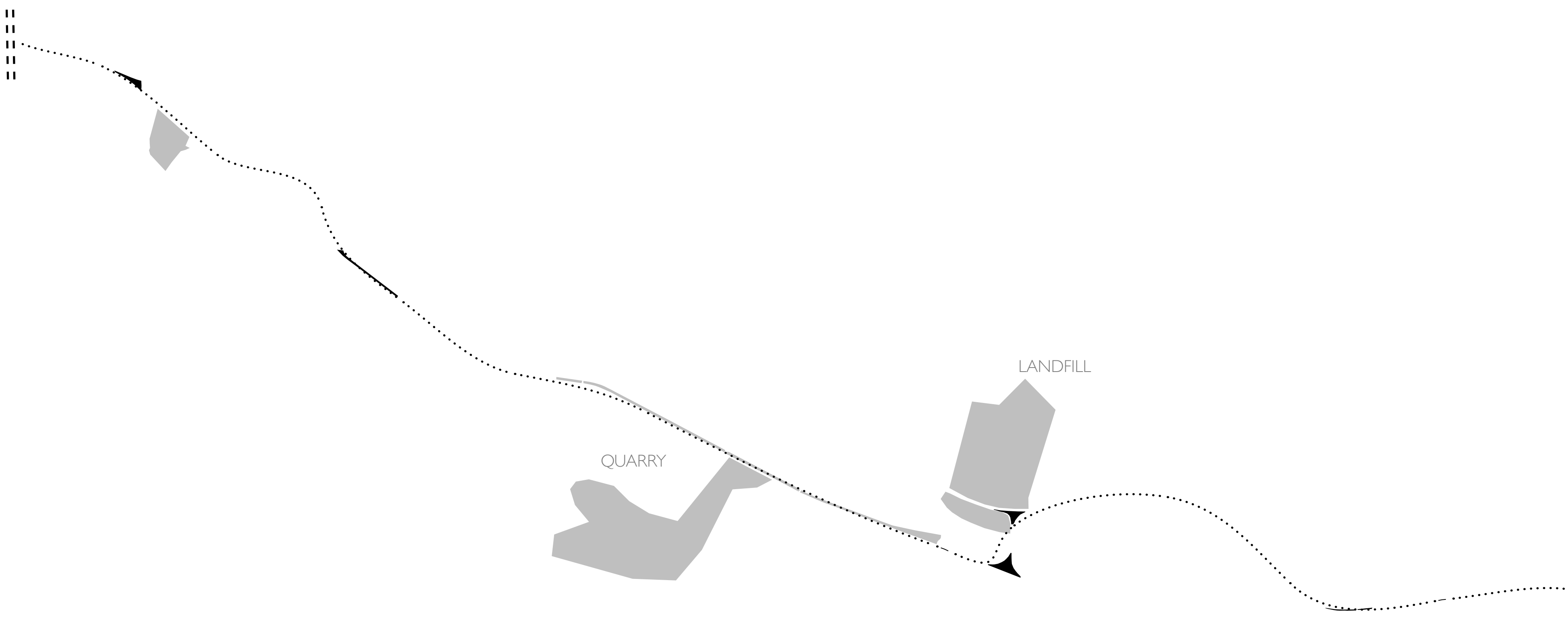

1 ACRE
5 ACRES
1 MILE
CORRIDOR SITE
ADJACENT SITE
MAINLINE ROUTE


FORMER INDUSTRIAL PARCELS
LEBANON
QUARRY
1 ACRE
5 ACRES
1 MILE
CORRIDOR SITE
ADJACENT SITE
MAINLINE ROUTE

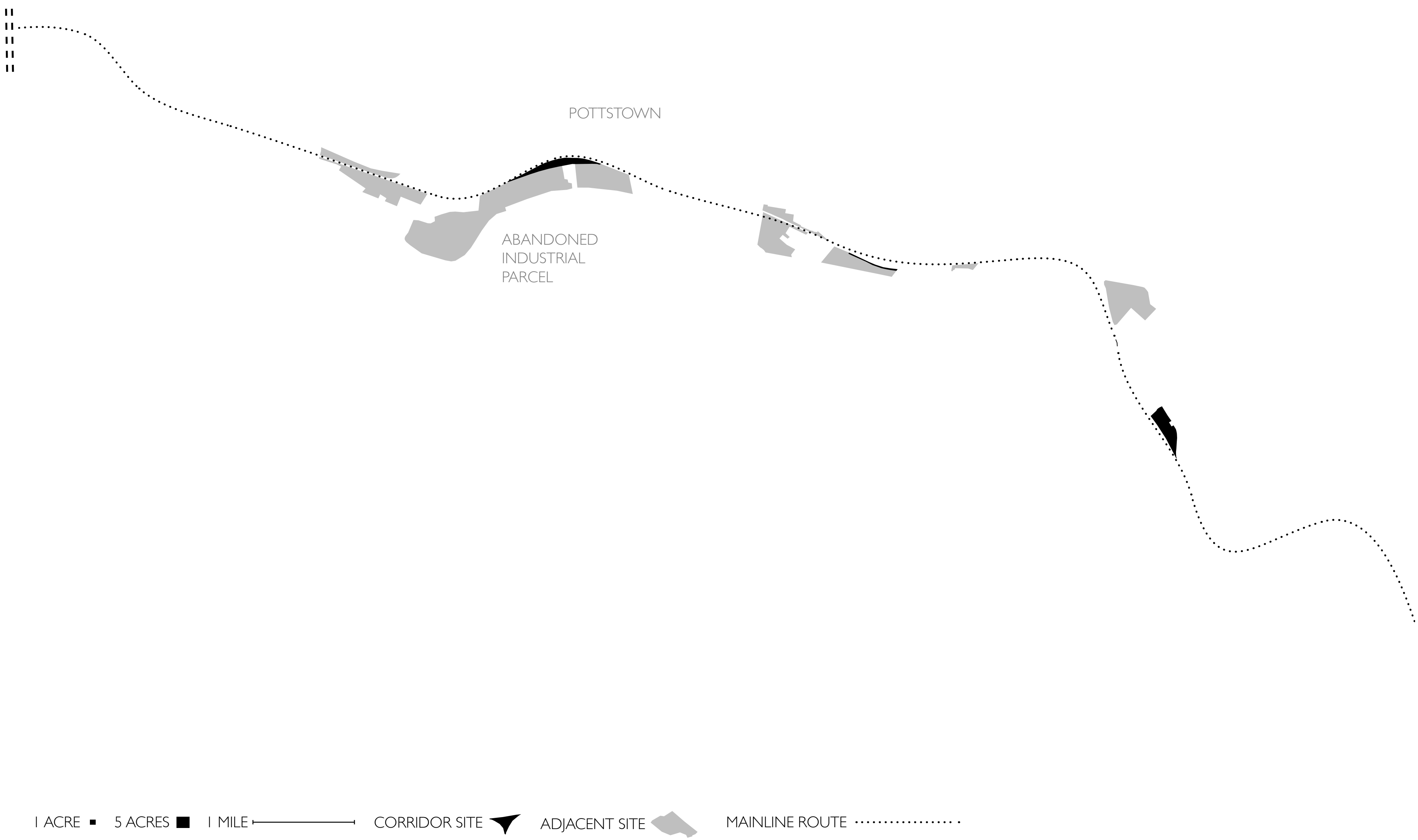

RICHLAND
ABANDONED
INDUSTRIAL
PARCEL

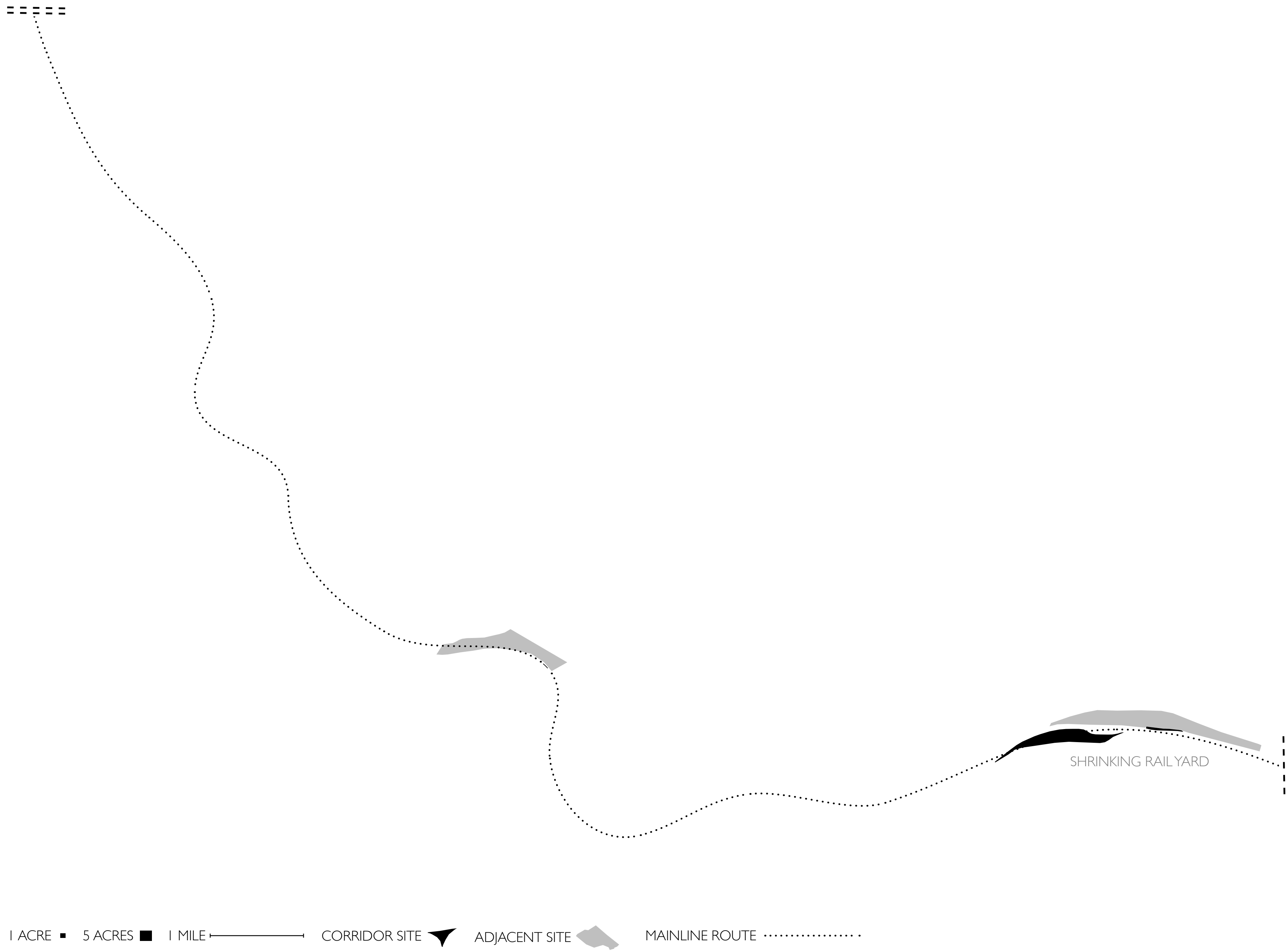

1 ACRE
5 ACRES
1 MILE
CORRIDOR SITE
ADJACENT SITE
MAINLINE ROUTE


RAIL JUNCTION
SPRINGMONT
I ACRE
5 ACRES
I MILE
CORRIDOR SITE
ADJACENT SITE
MAINLINE ROUTE

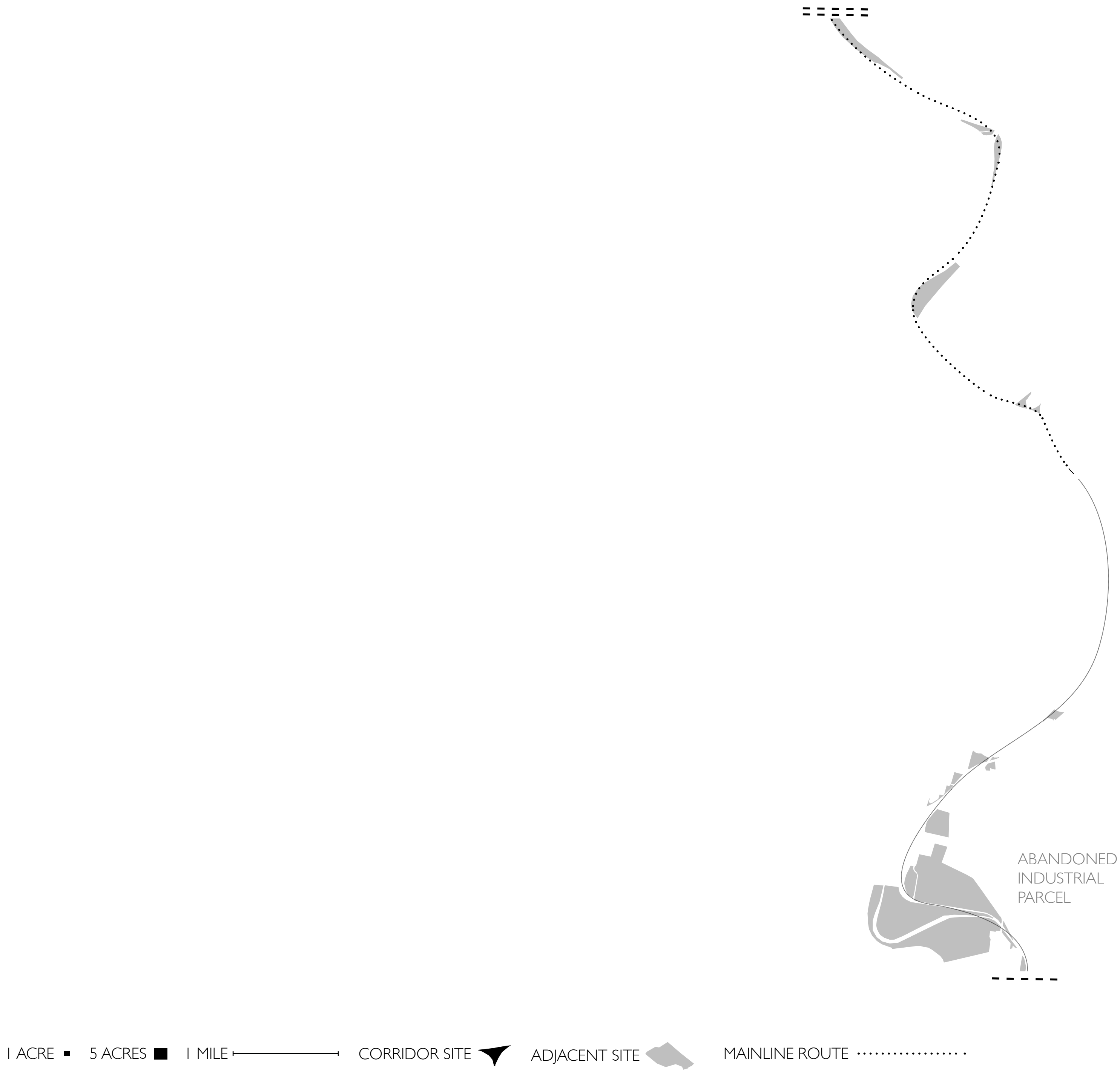


1 ACRE ▪ 5 ACRES ■ 1 MILE CORRIDOR SITE ADJACENT SITE MAINLINE ROUTE


POTTSTOWN
ABANDONED
INDUSTRIAL
PARCEL
1 ACRE
5 ACRES
1 MILE
CORRIDOR SITE
ADJACENT SITE
MAINLINE ROUTE


SHRINKING RAIL YARD
1 ACRE
5 ACRES
1 MILE
CORRIDOR SITE
ADJACENT SITE
MAINLINE ROUTE


QUARRY /
ABANDONED
INDUSTRIAL
PARCEL
1 ACRE
5 ACRES
1 MILE
CORRIDOR SITE
ADJACENT SITE
MAINLINE ROUTE


ABANDONED
INDUSTRIAL
PARCEL
1 ACRE
5 ACRES
1 MILE
CORRIDOR SITE
ADJACENT SITE
MAINLINE ROUTE

1 ACRE ▪ 5 ACRES ■ 1 MILE —— CORRIDOR SITE ADJACENT SITE MAINLINE ROUTE ··················

Appendix C:

Susquehanna-Roseland Linear Site Catalog

Sites along Susquehanna-Roseland are presented in a figure-ground diagram as the sites exist along the length of the corridor. A single dashed line indicates that the corridor continues on the next page; a double dashed line indicates where the corridor continues on that page.

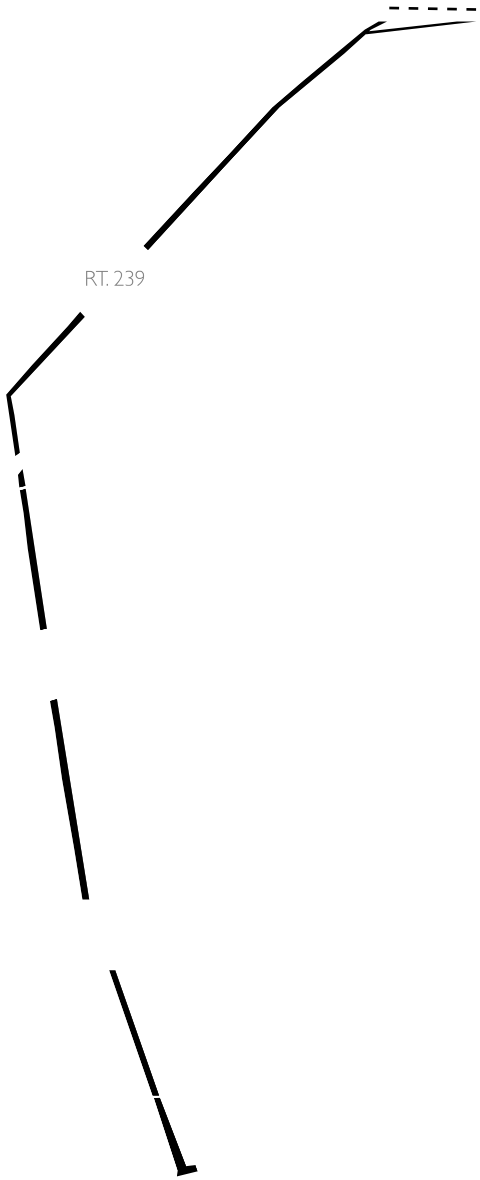
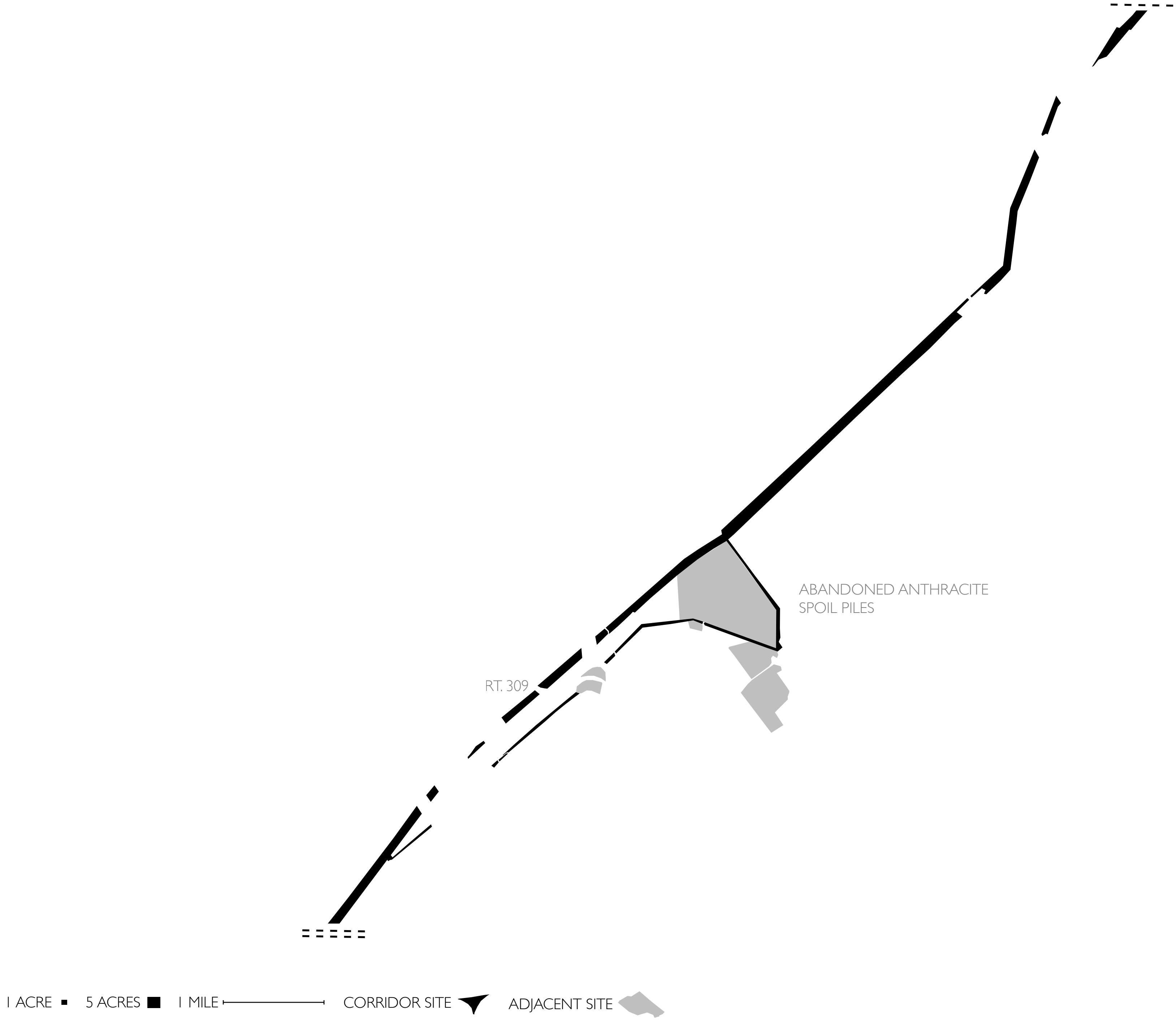
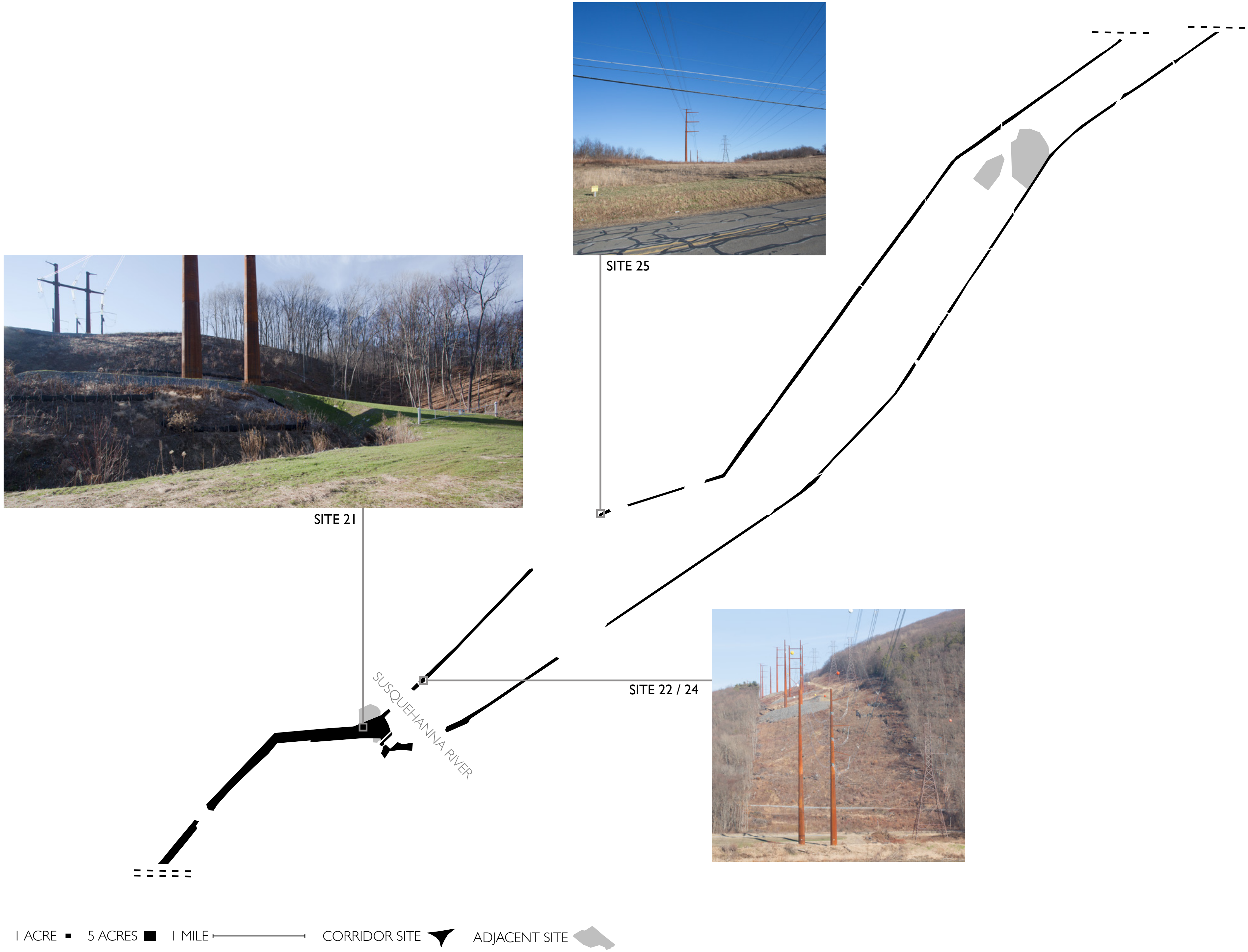
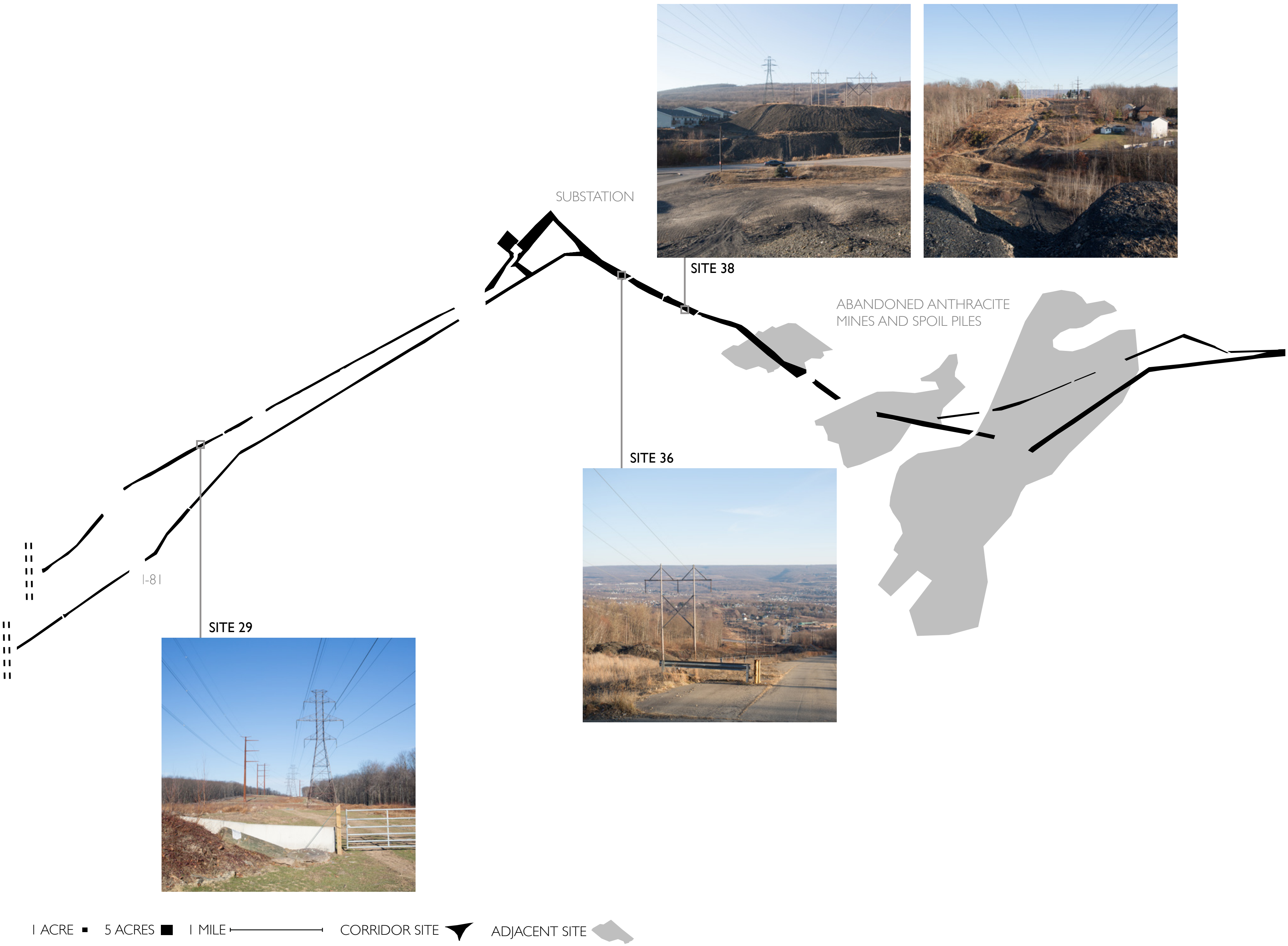


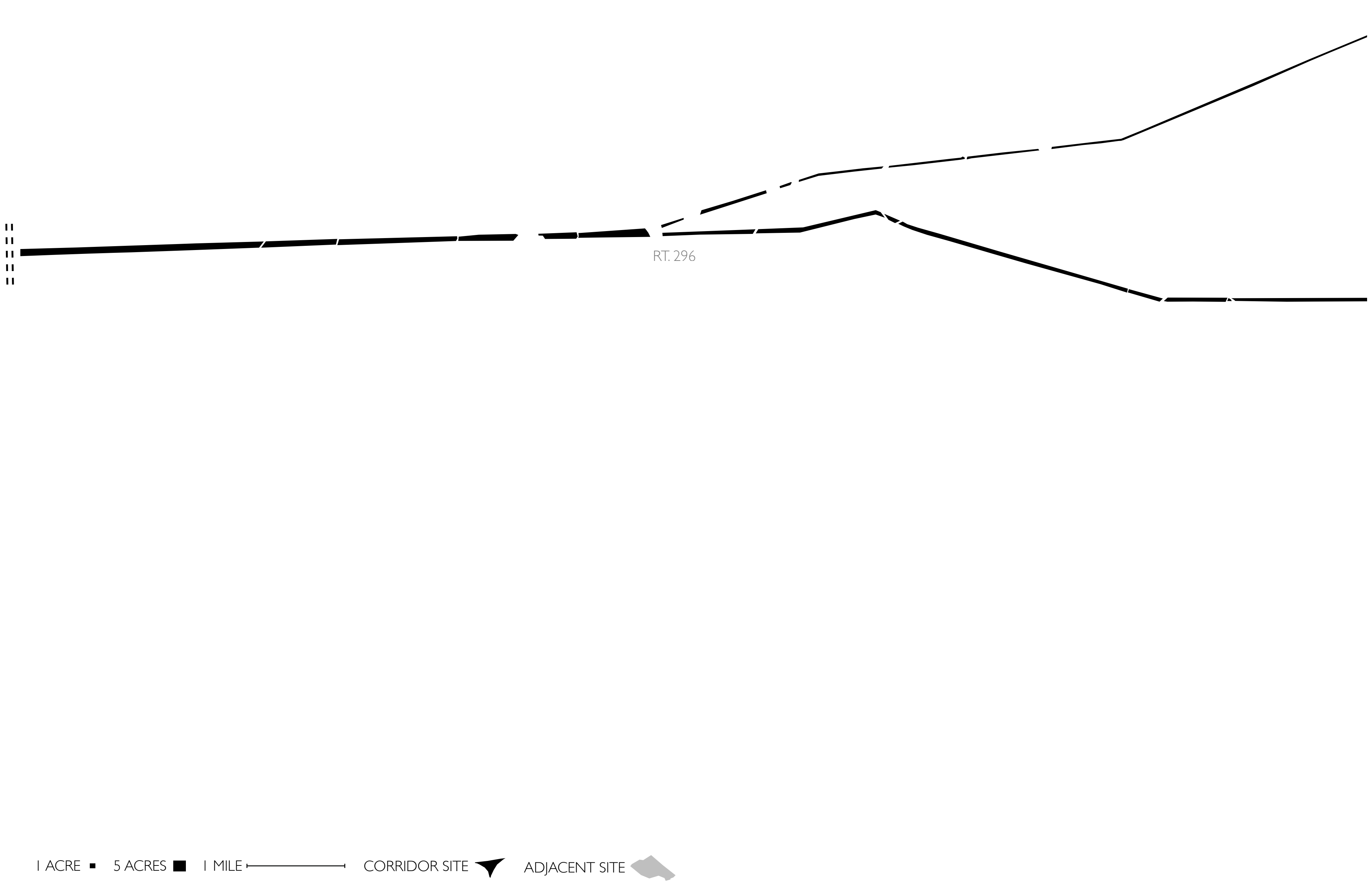
Figure 94 Susquehanna-Roseland Electric Transmission Line Linear Site Catalog


SUBSTATION
RT. 29
1 ACRE
5 ACRES
1 MILE
CORRIDOR SITE
ADJACENT SITE

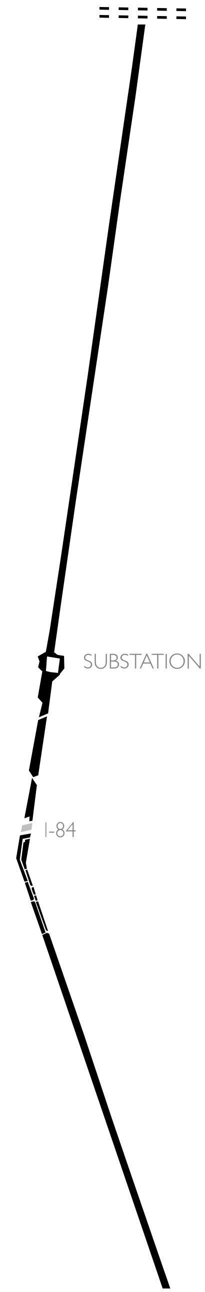

ABANDONED ANTHRACITE
SPOIL PILES
RT. 309
1 ACRE
5 ACRES
1 MILE
CORRIDOR SITE
ADJACENT SITE

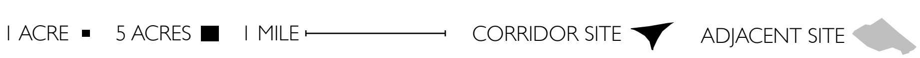

SITE 25
SITE 21
SITE 22 / 24
SUSQUEHANNA RIVER
1 ACRE
5 ACRES
1 MILE
CORRIDOR SITE
ADJACENT SITE

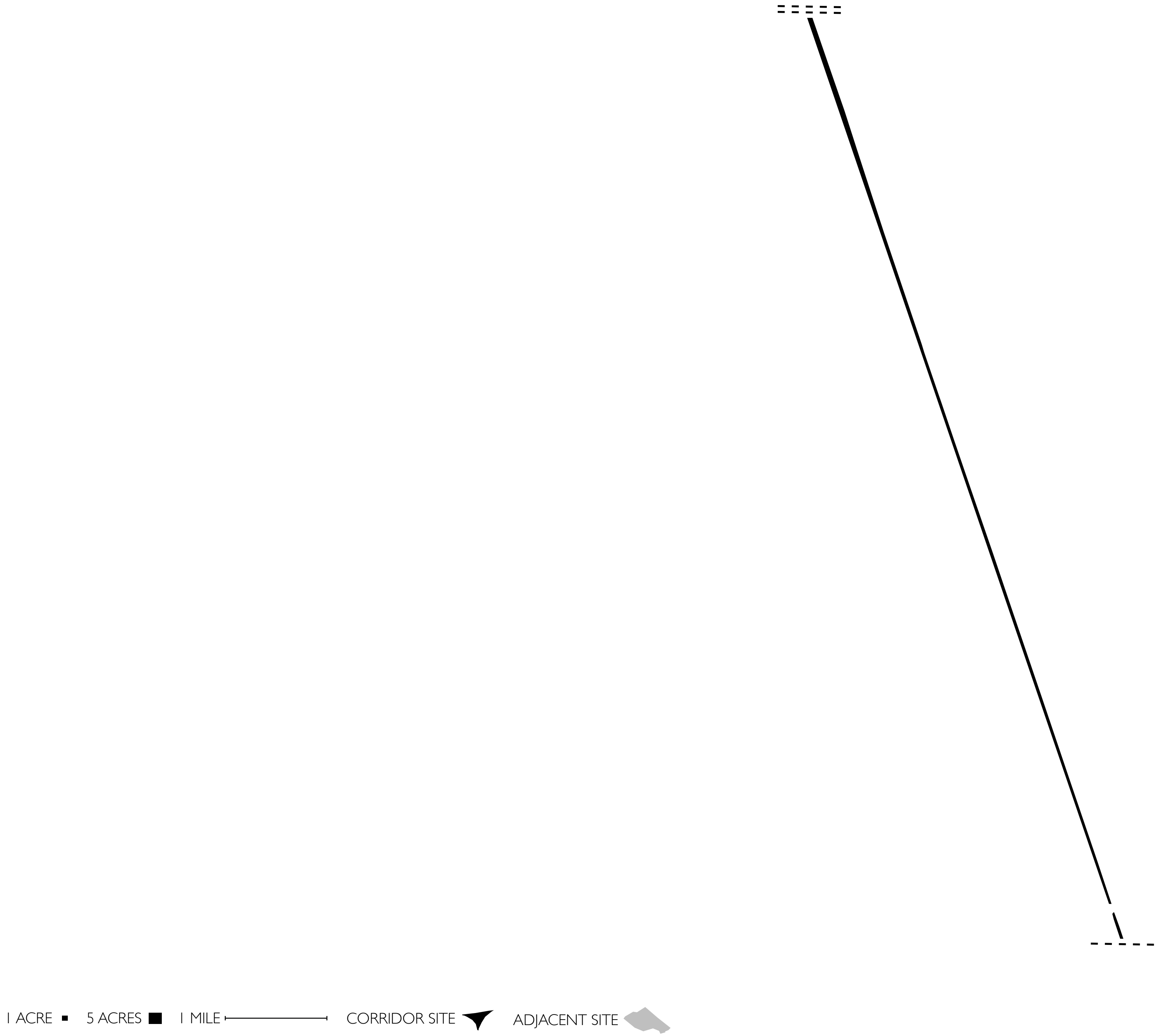

SUBSTATION
SITE 38
ABANDONED ANTHRACITE MINES AND SPOIL PILES
SITE 36
I-81
SITE 29
1 ACRE
5 ACRES
1 MILE
CORRIDOR SITE
ADJACENT SITE

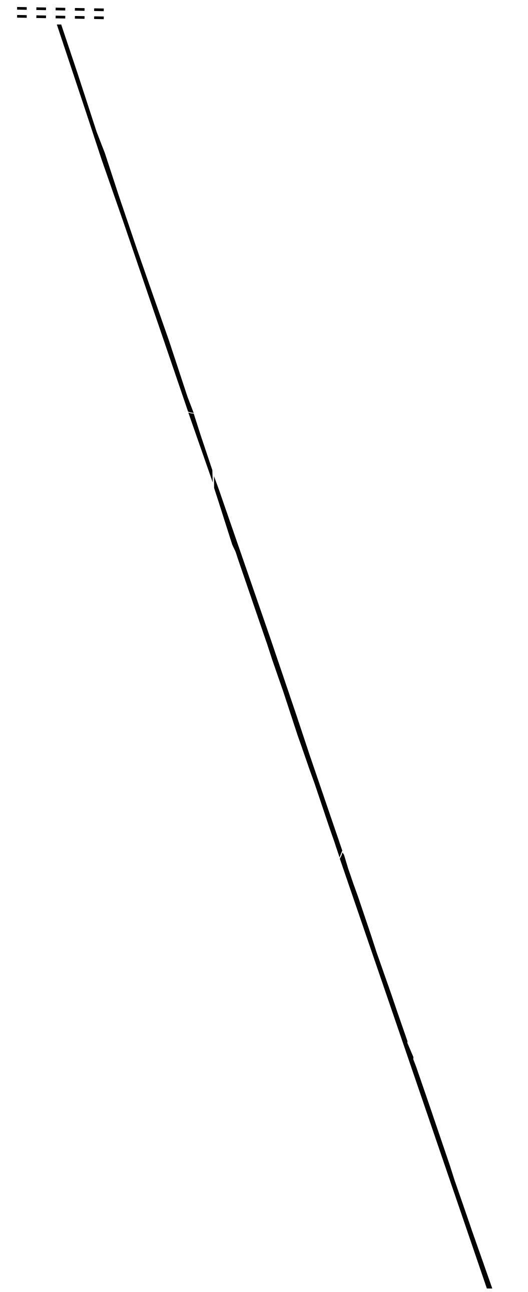

RT. 296
1 ACRE
5 ACRES
1 MILE
CORRIDOR SITE
ADJACENT SITE


RT. 6
1 ACRE
5 ACRES
1 MILE
CORRIDOR SITE
ADJACENT SITE

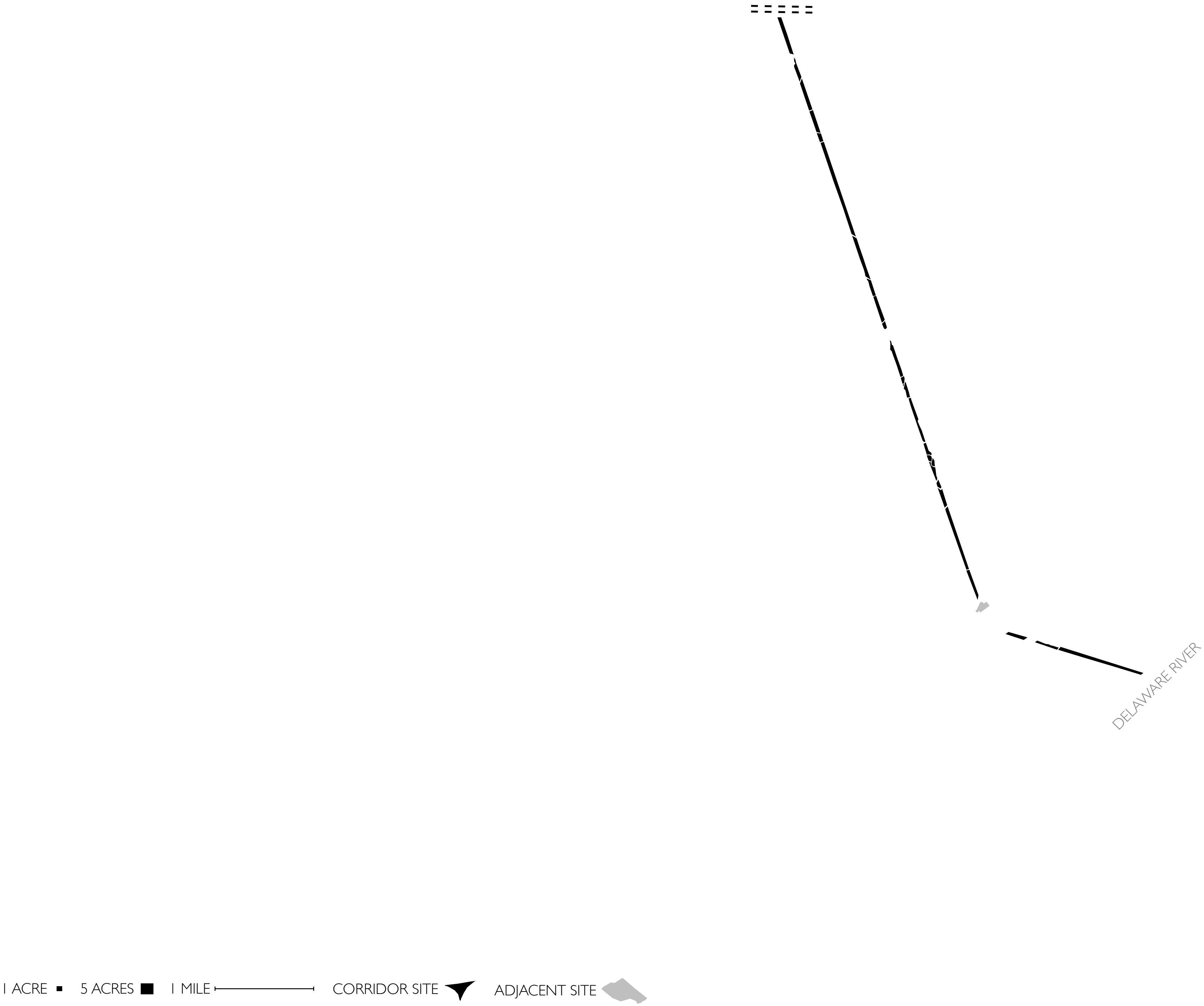

SUBSTATION
I-84


1 ACRE
5 ACRES
1 MILE
CORRIDOR SITE
ADJACENT SITE


1 ACRE
5 ACRES
1 MILE
CORRIDOR SITE
ADJACENT SITE



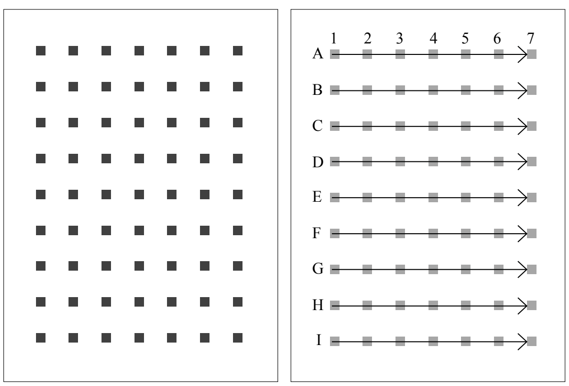
I ACRE ▪ 5 ACRES ■ I MILE CORRIDOR SITE ADJACENT SITE


DELAWARE RIVER
1 ACRE
5 ACRES
1 MILE
CORRIDOR SITE
ADJACENT SITE

Appendix D:

Interstate 80 Grid Site Catalog

Sites along Interstate 80 have been removed from their spatial order and rearranged in a 7 x 9 grid. Sites are placed in the grid with the first site at the top of the first page as the western-most site along the corridor. Each column moves progressively along the corridor. As shown in the diagram below, each row starts on the left edge of the paper. Reading the sites from left to right, as reading a book, provides an approximate west to east reading of the corridor. When a site was too large to be accomodated in the grid, it was given more than its alloted space, displacing later sites.



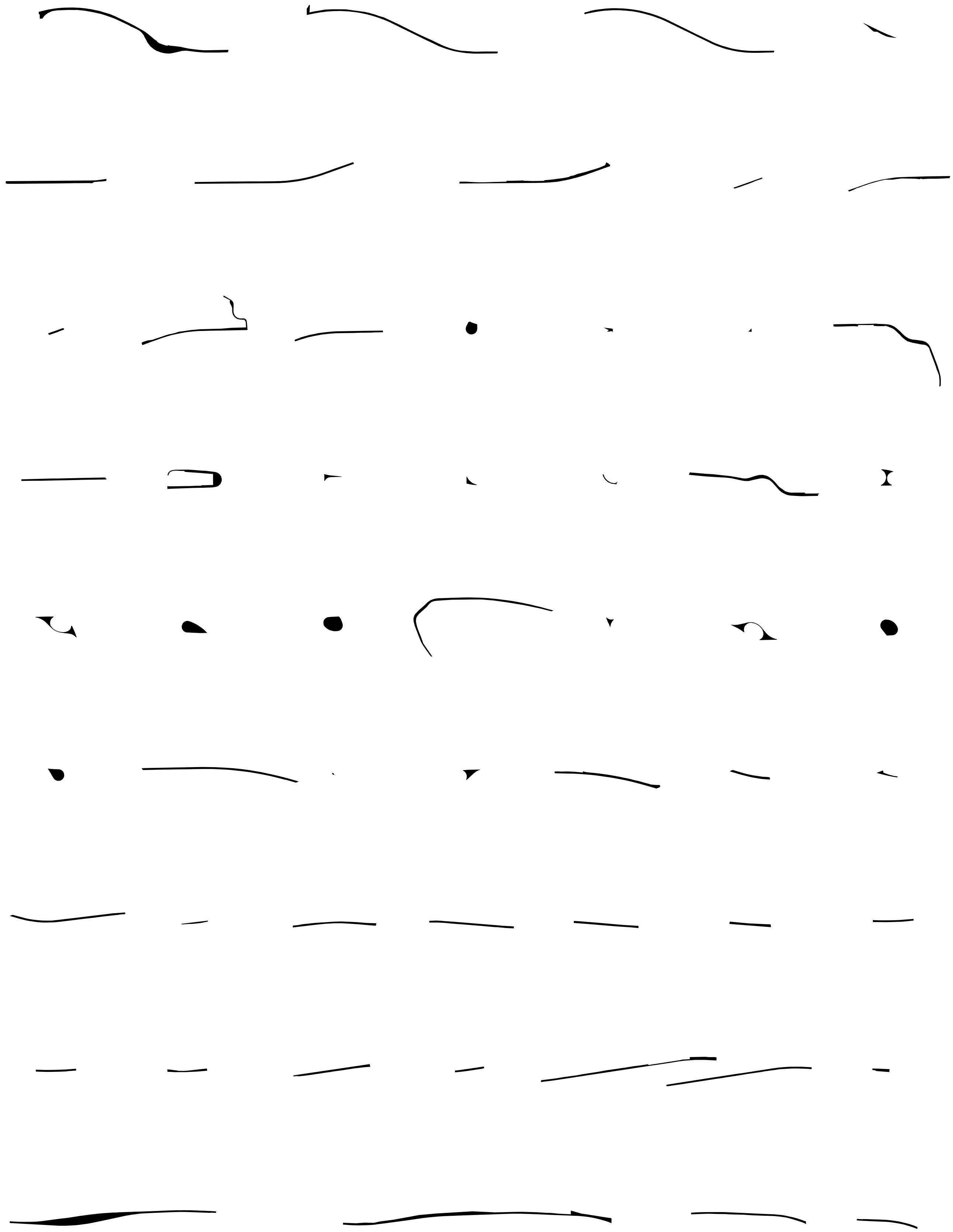
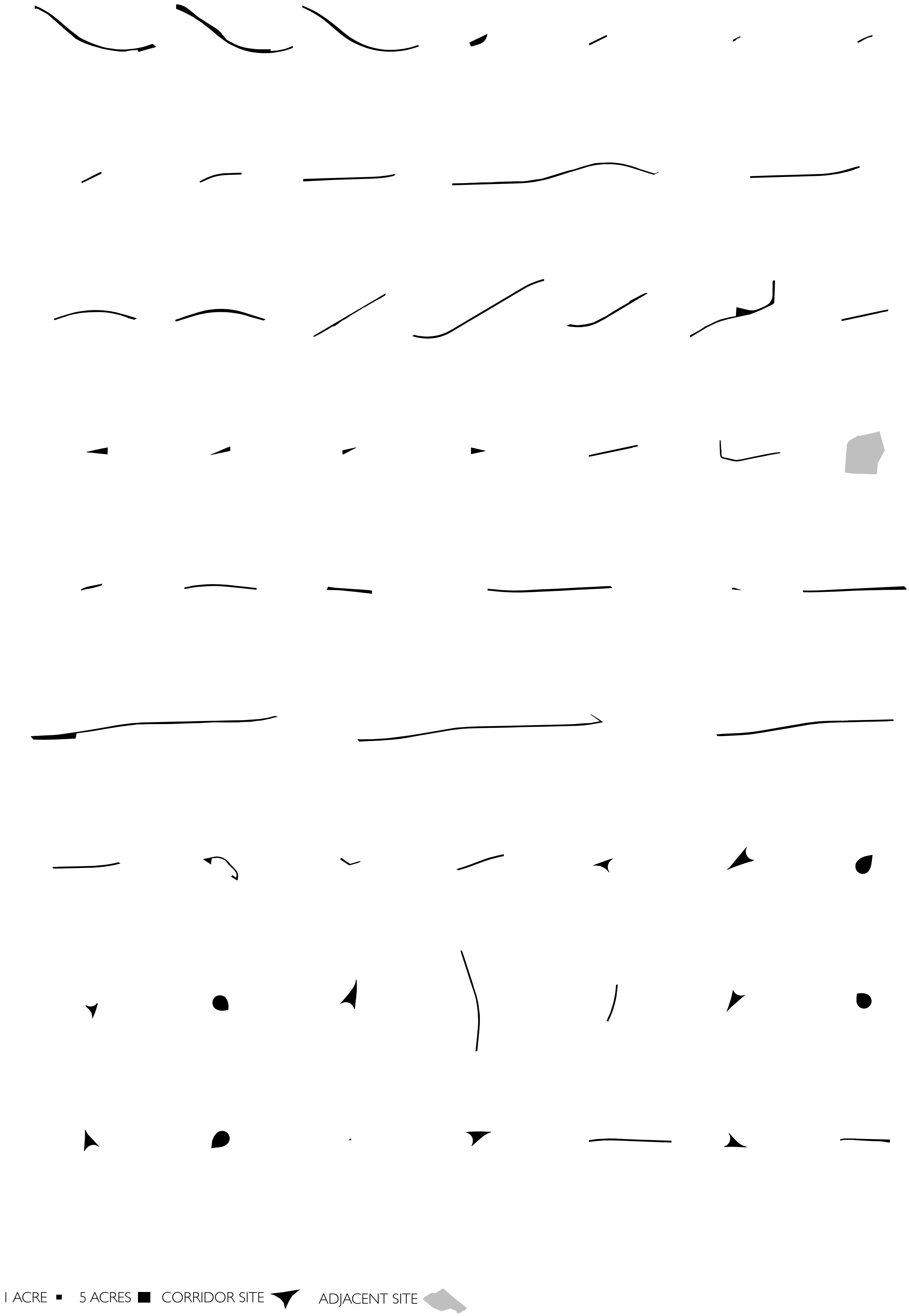
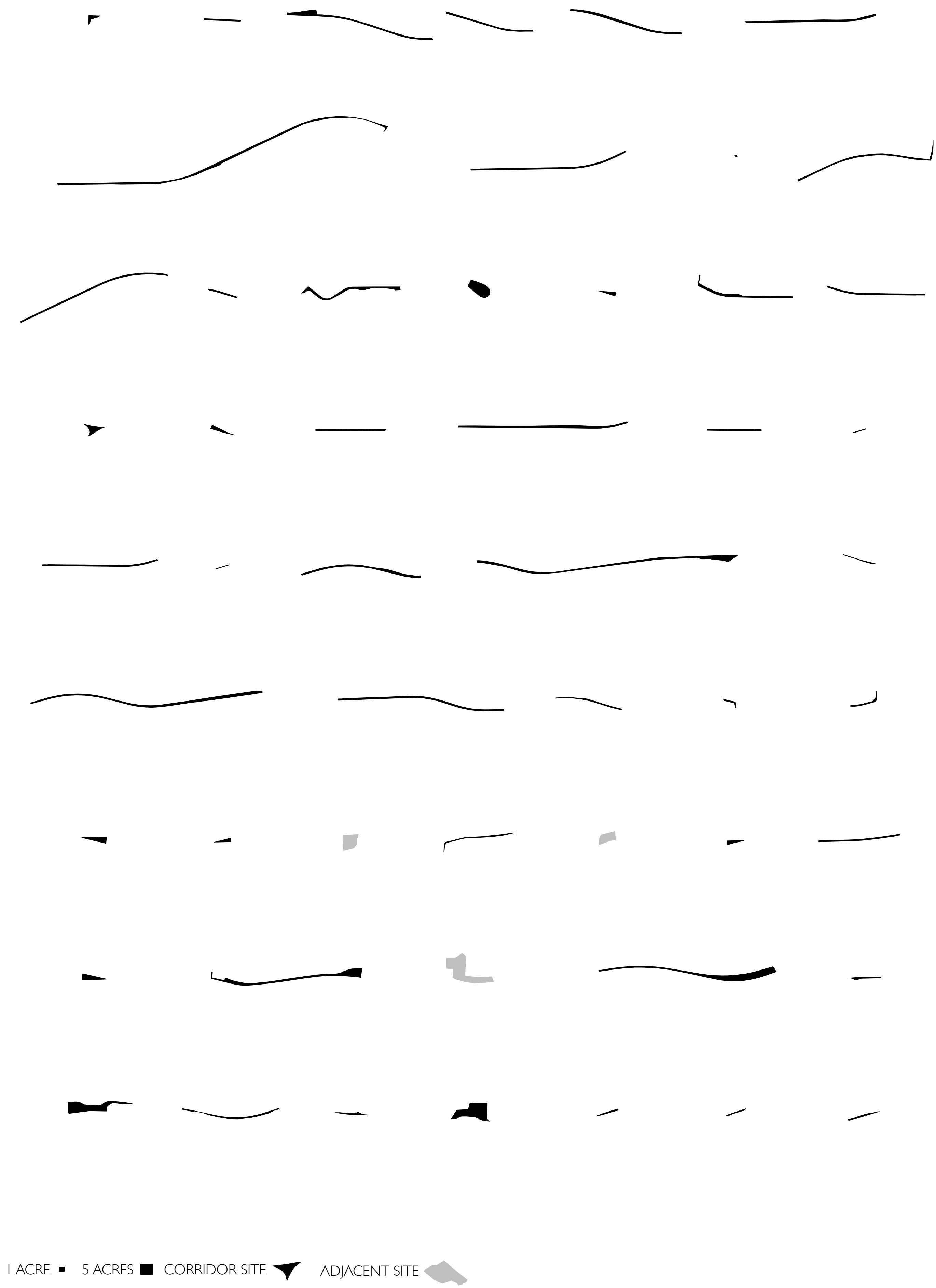
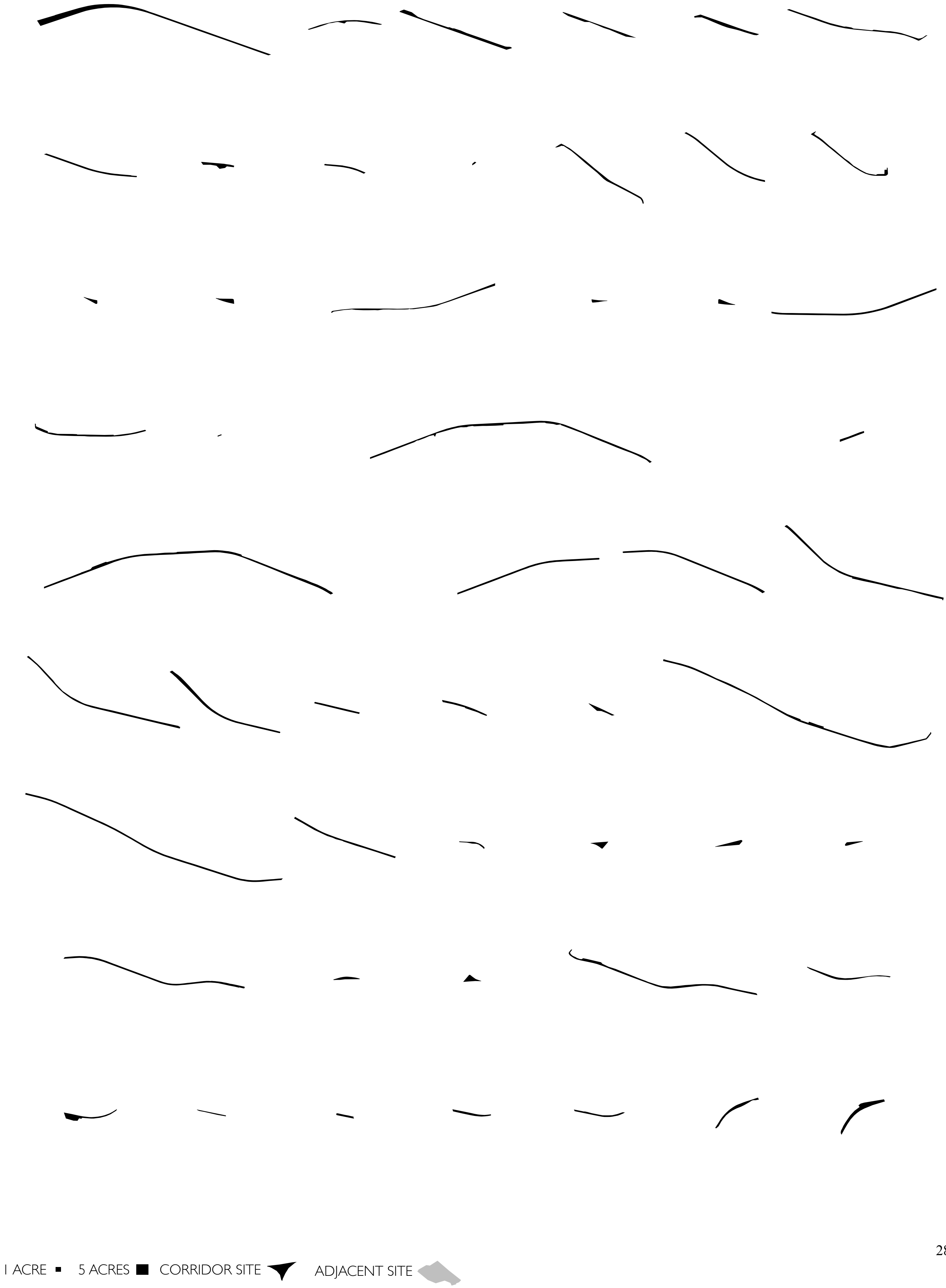


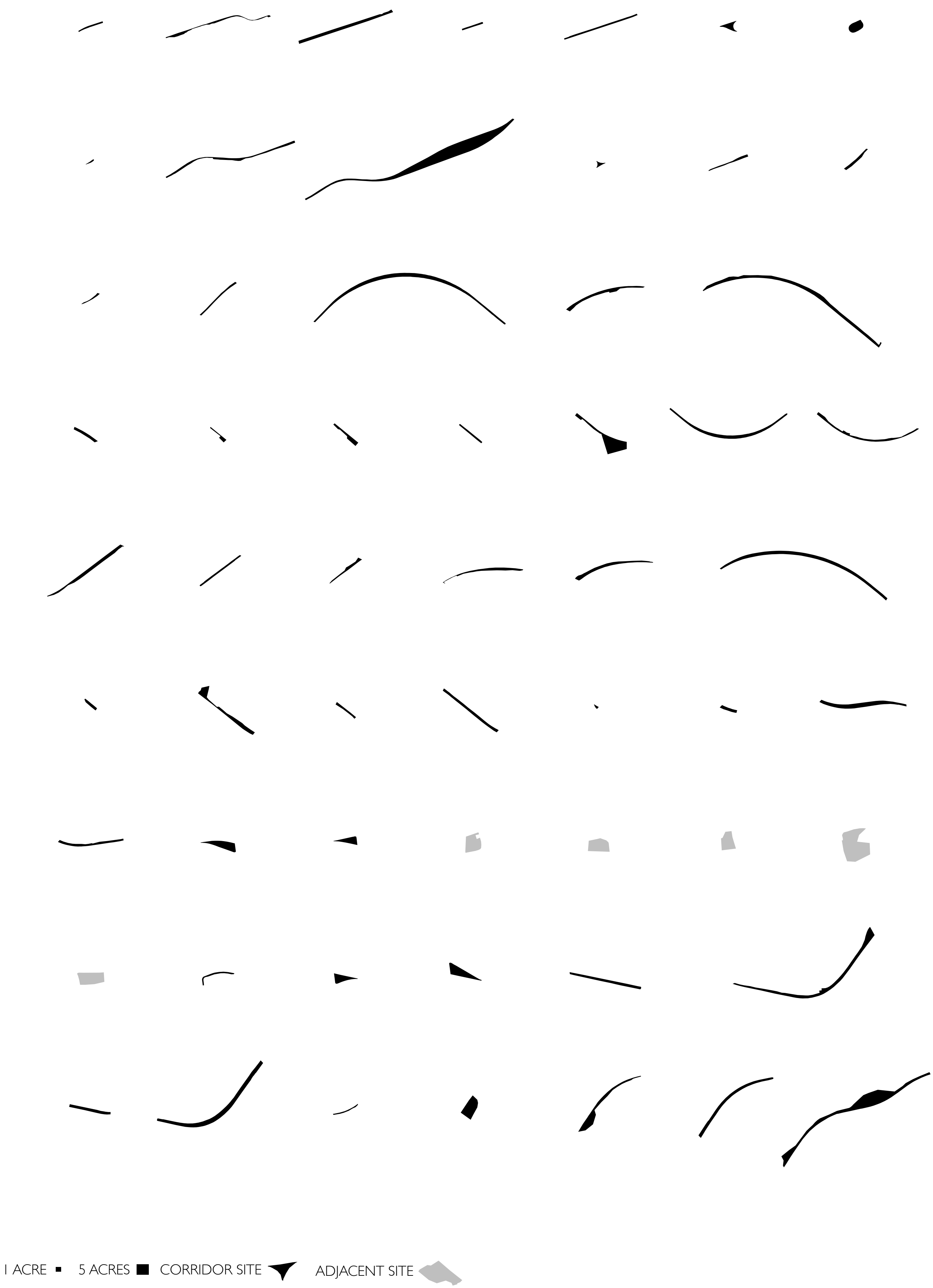
Figure 95 Interstate 80 Grid Site Catalog

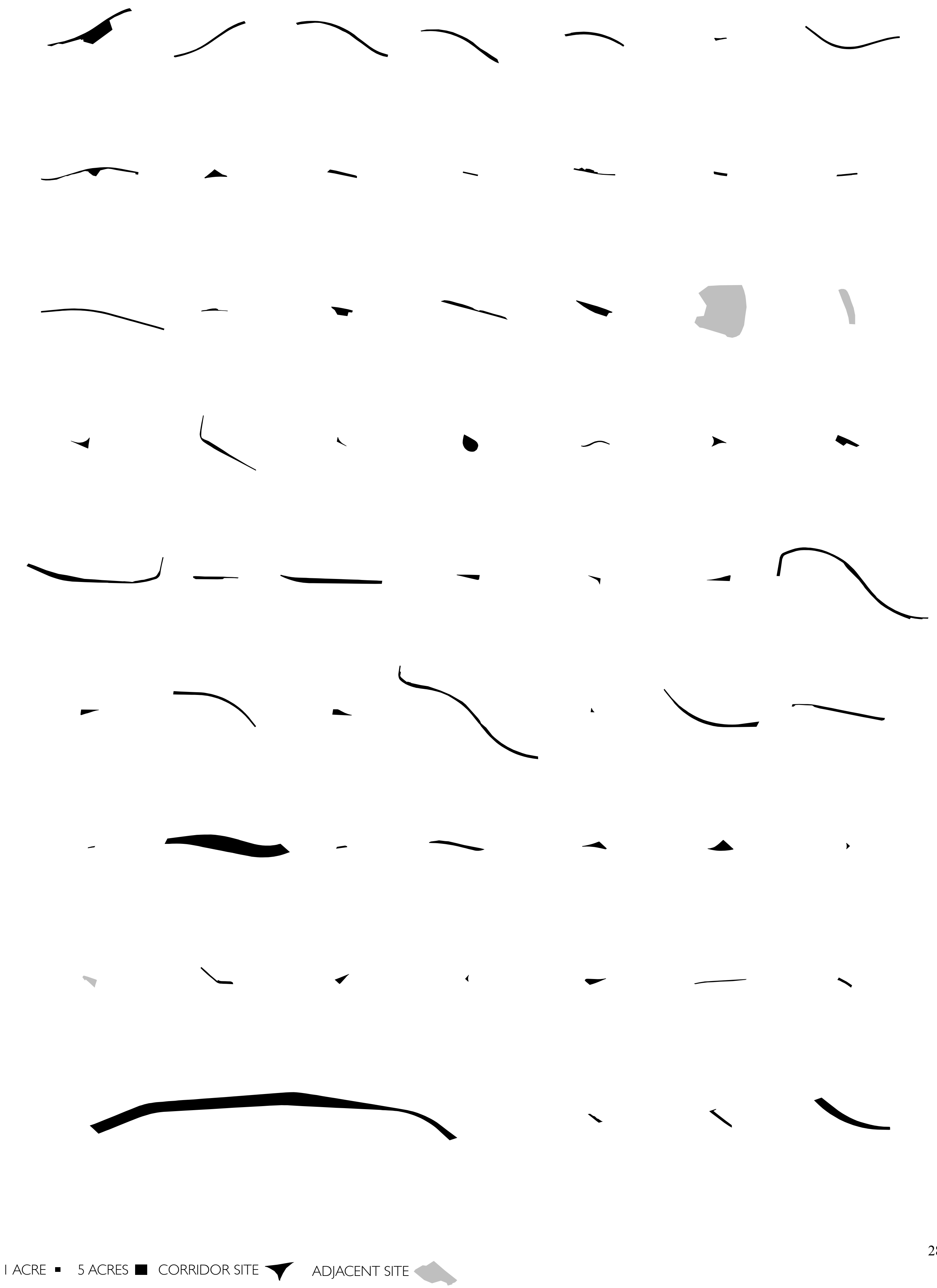
I ACRE ▪ 5 ACRES ■ CORRIDOR SITE ADJACENT SITE

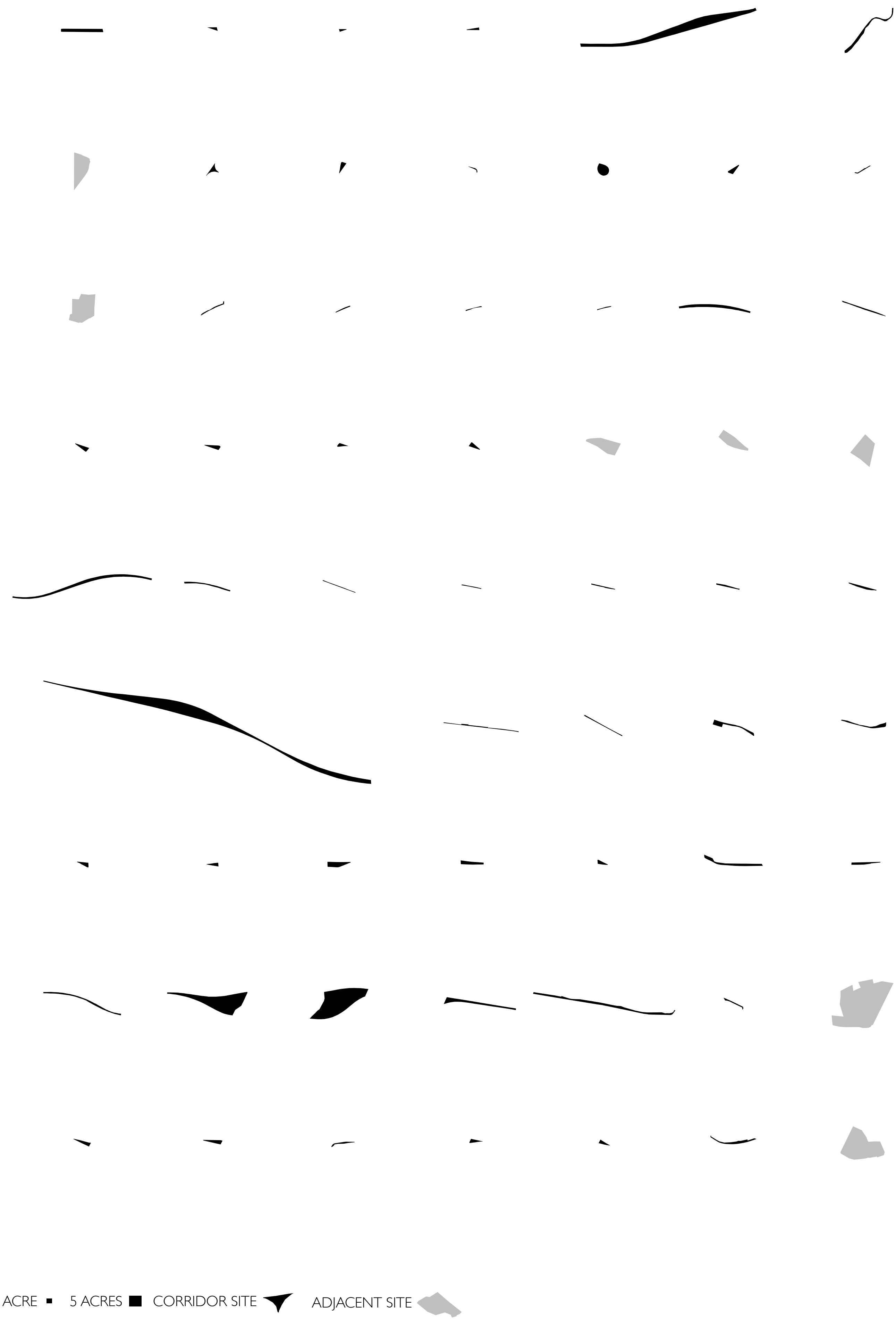

1 ACRE
5 ACRES
CORRIDOR SITE
ADJACENT SITE

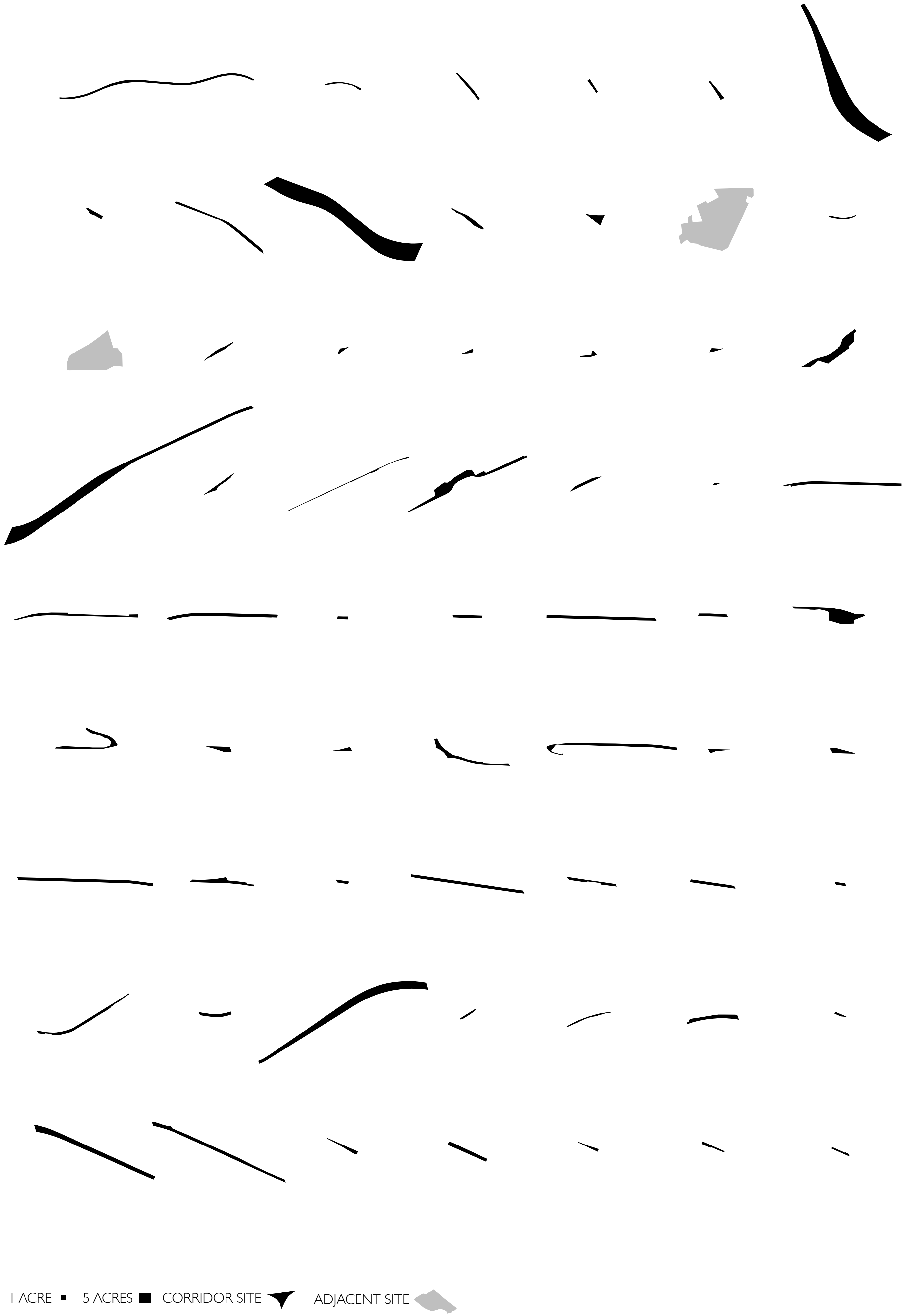

I ACRE
5 ACRES
CORRIDOR SITE
ADJACENT SITE

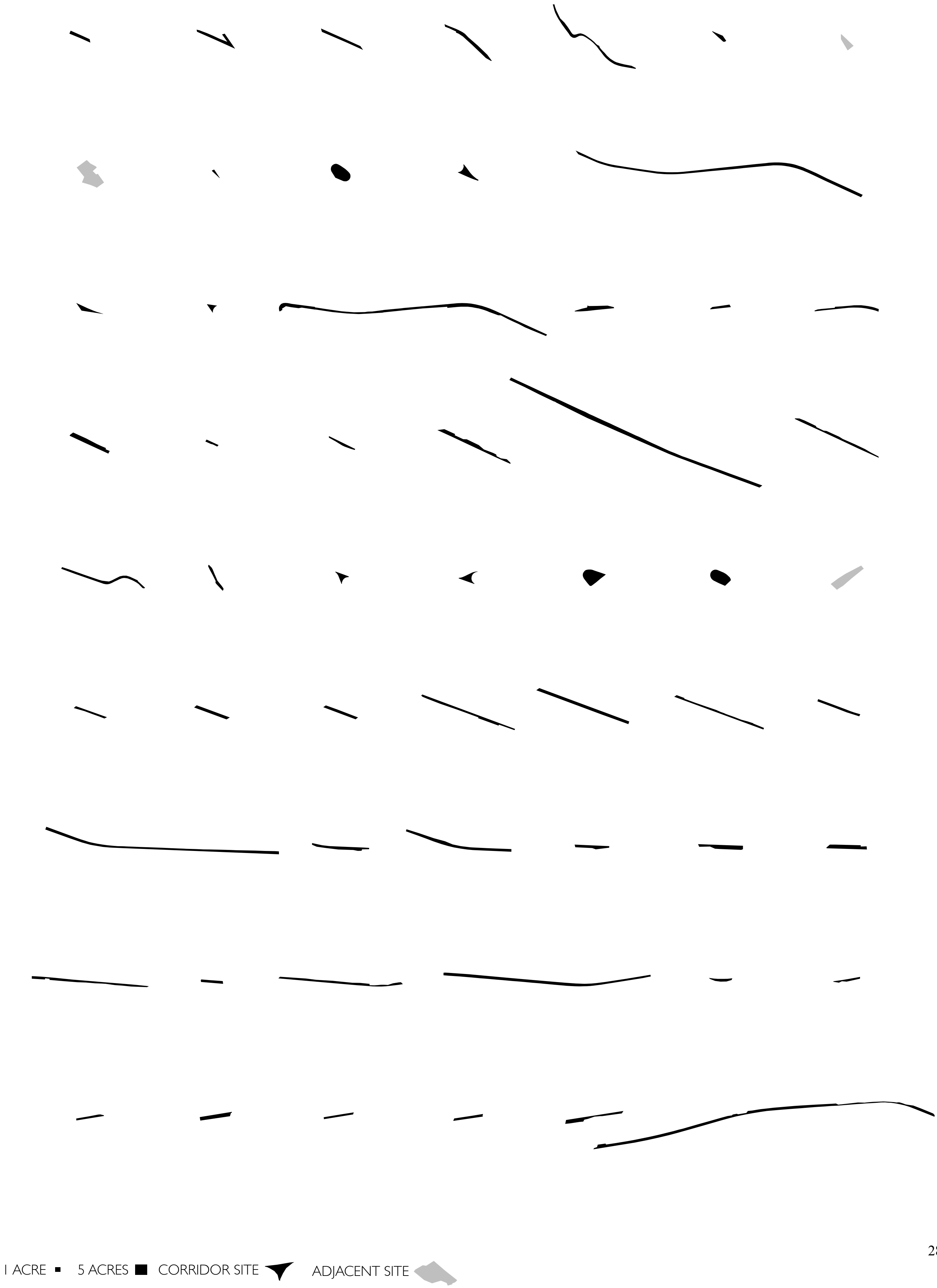

I ACRE
5 ACRES
CORRIDOR SITE
ADJACENT SITE

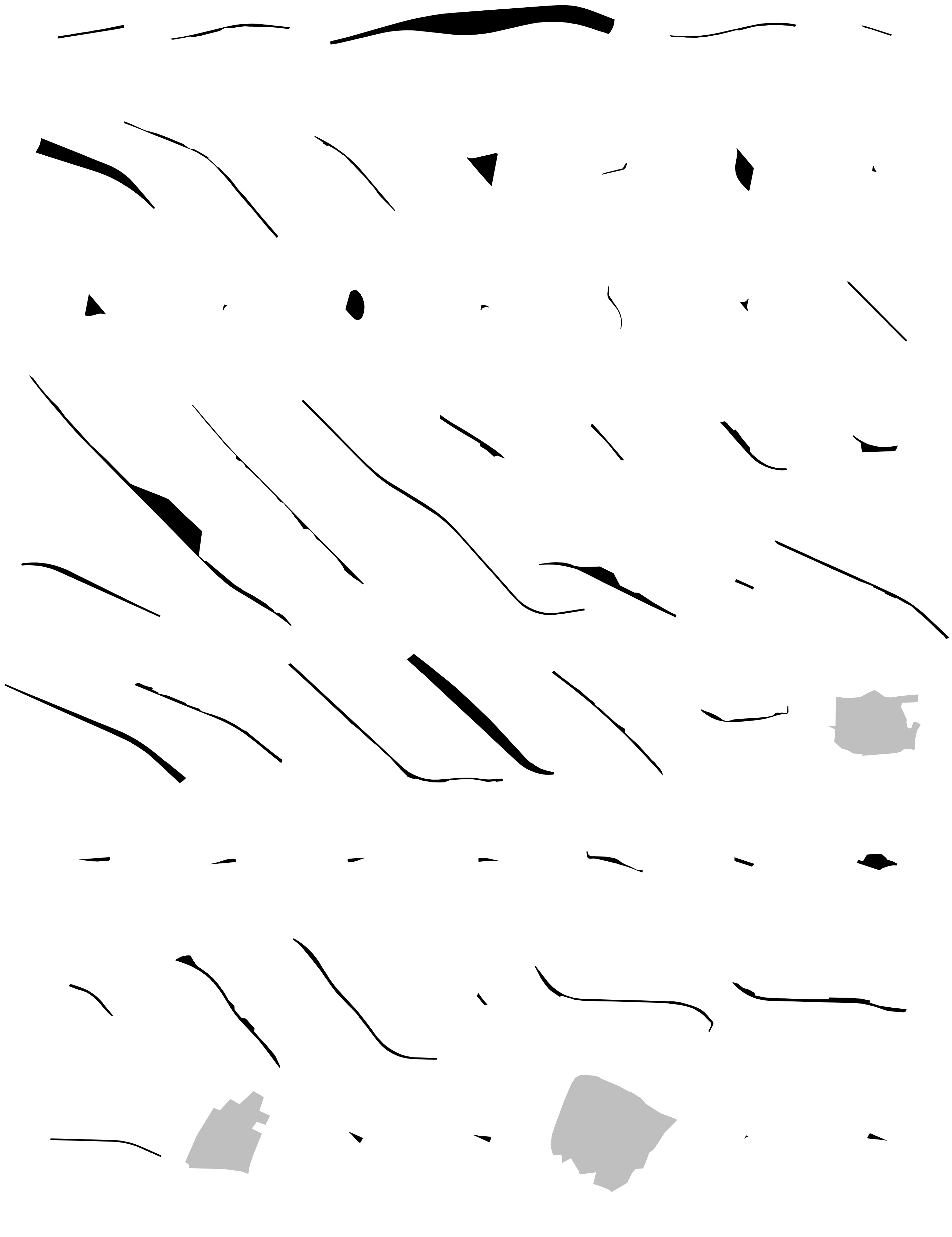

1 ACRE
5 ACRES
CORRIDOR SITE
ADJACENT SITE


1 ACRE
5 ACRES
CORRIDOR SITE
ADJACENT SITE

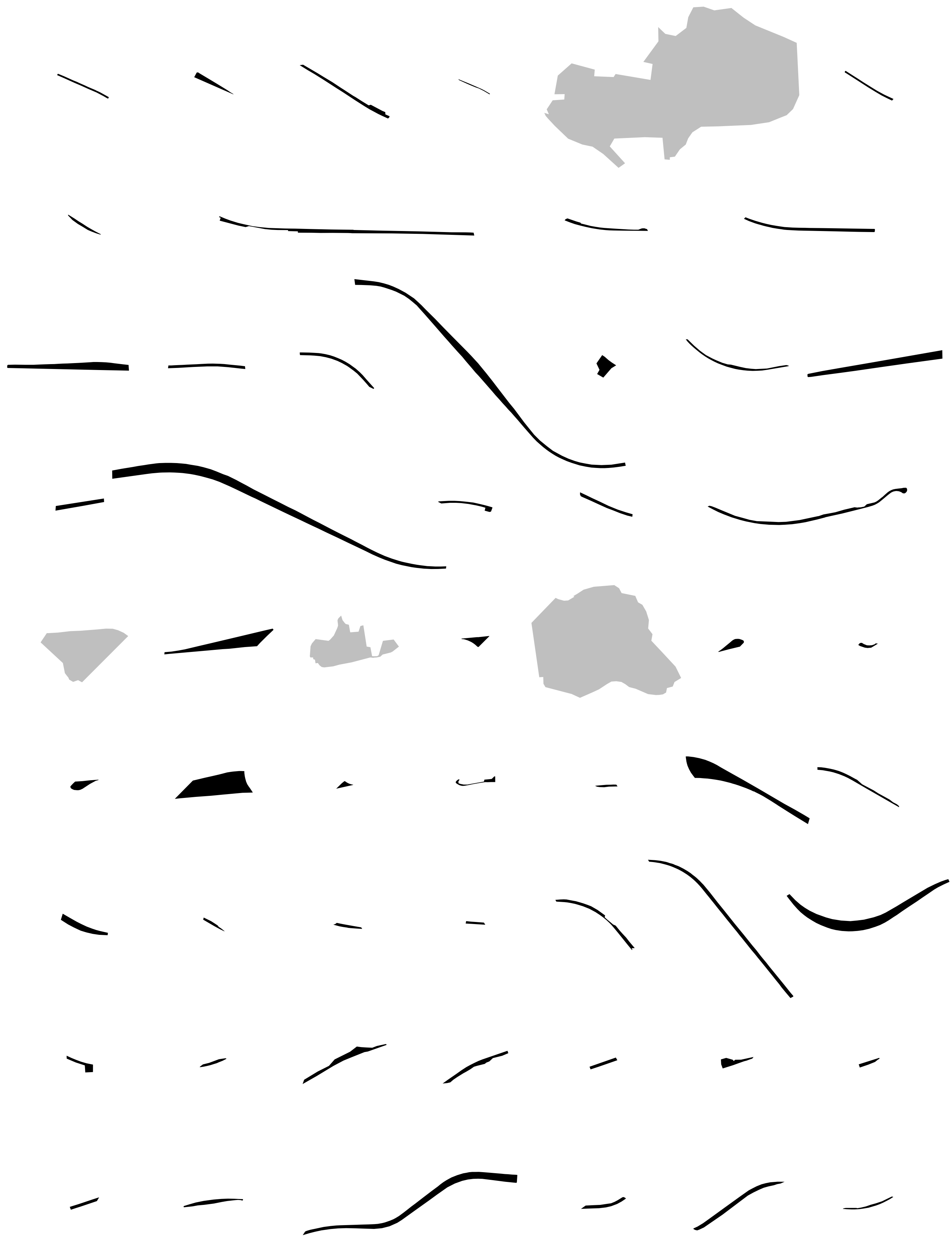

1 ACRE
5 ACRES
CORRIDOR SITE
ADJACENT SITE


1 ACRE
5 ACRES
CORRIDOR SITE
ADJACENT SITE

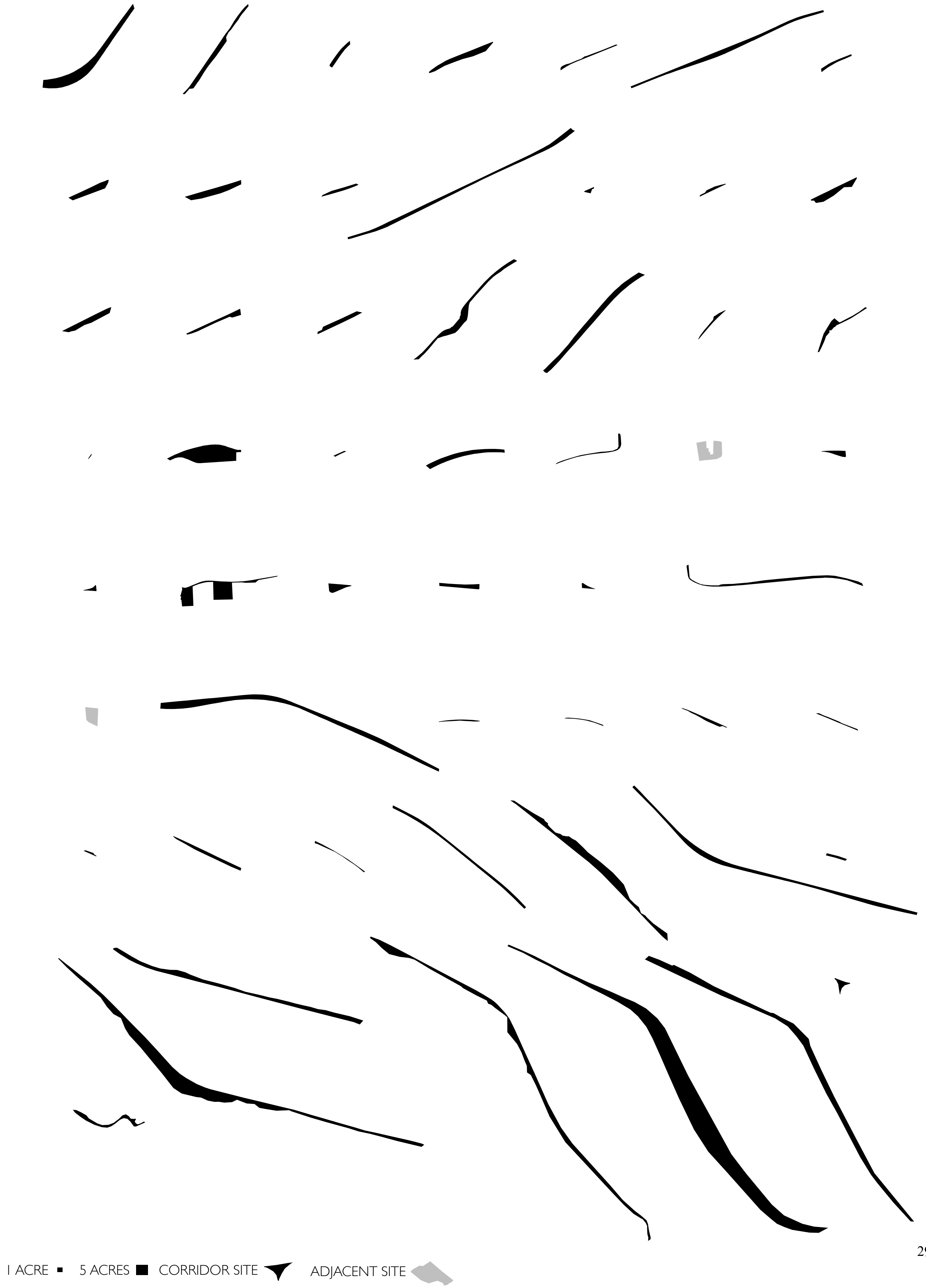

1 ACRE
5 ACRES
CORRIDOR SITE
ADJACENT SITE



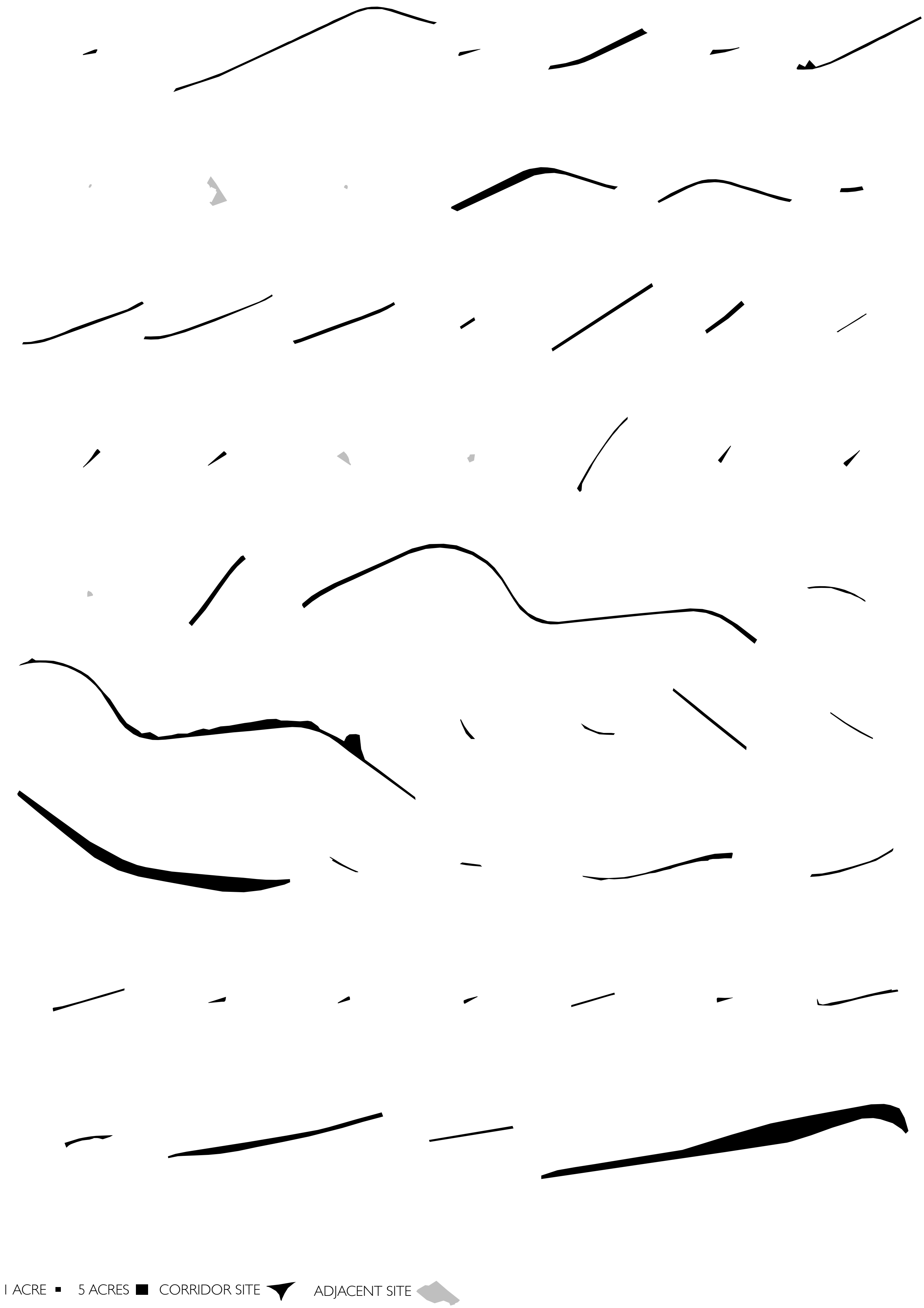
1 ACRE ▪ 5 ACRES ■ CORRIDOR SITE ADJACENT SITE

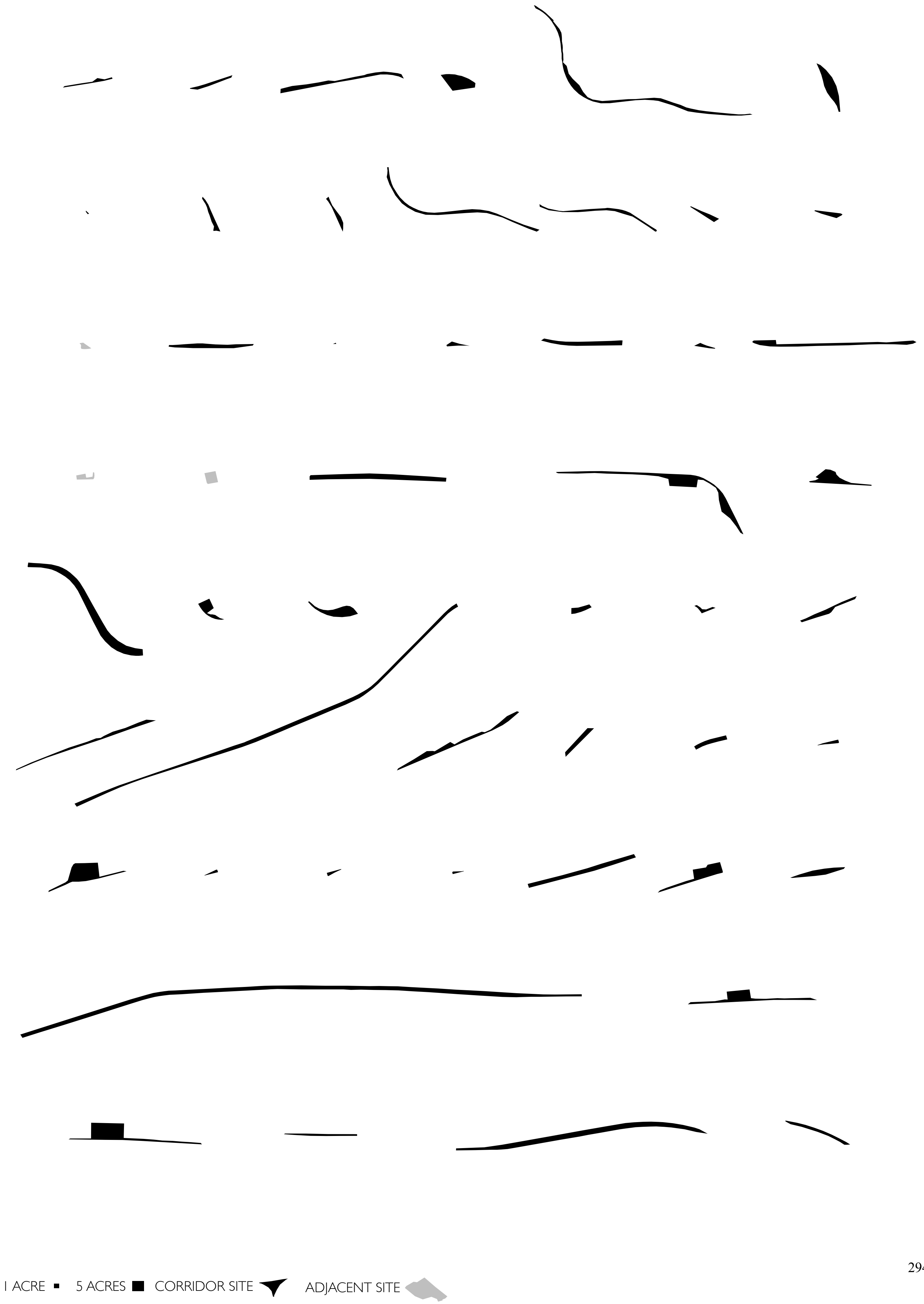


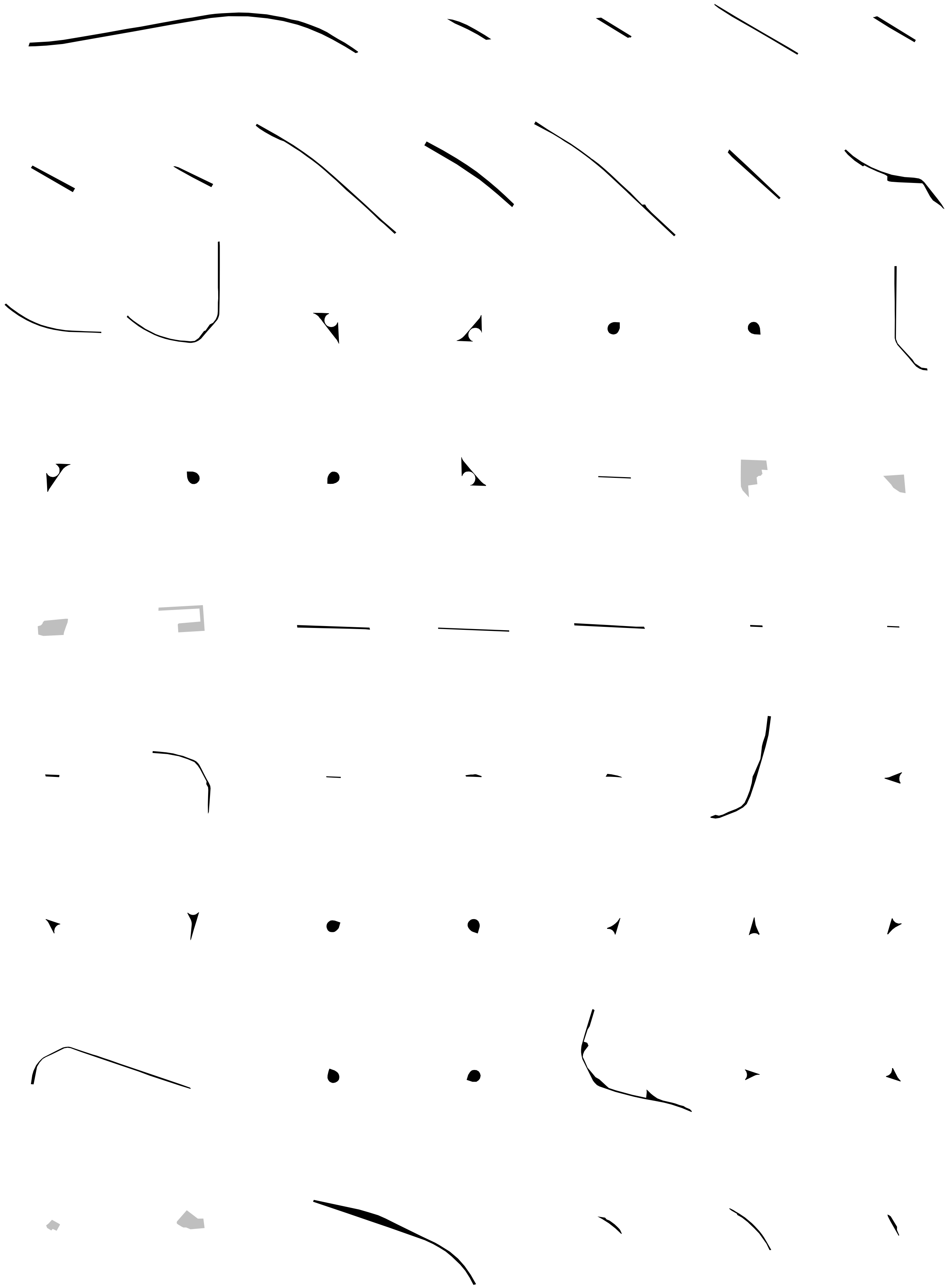
1 ACRE ▪ 5 ACRES ■ CORRIDOR SITE ADJACENT SITE


I ACRE
5 ACRES
CORRIDOR SITE
ADJACENT SITE

1 ACRE
5 ACRES
CORRIDOR SITE
ADJACENT SITE

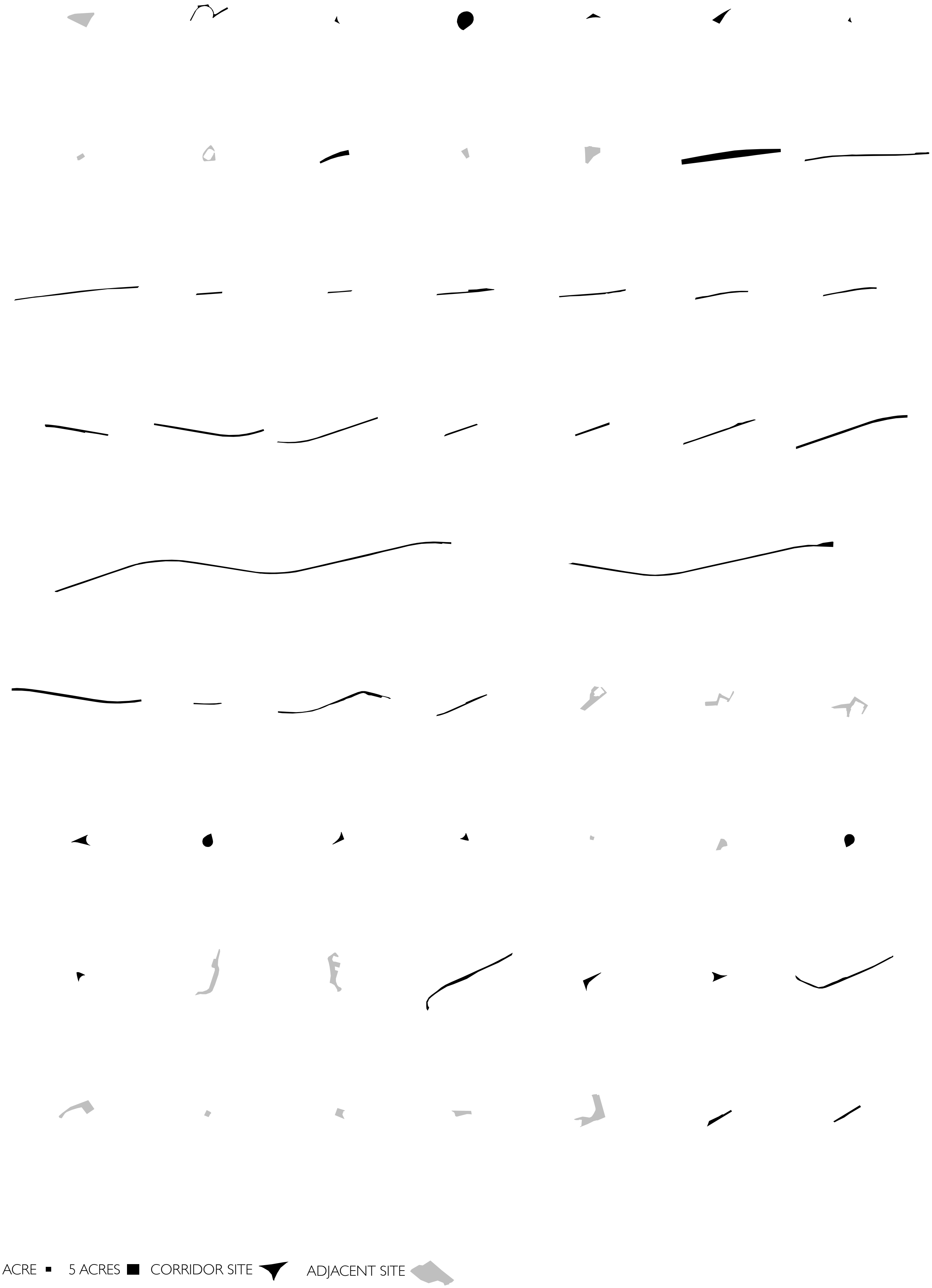

1 ACRE
5 ACRES
CORRIDOR SITE
ADJACENT SITE

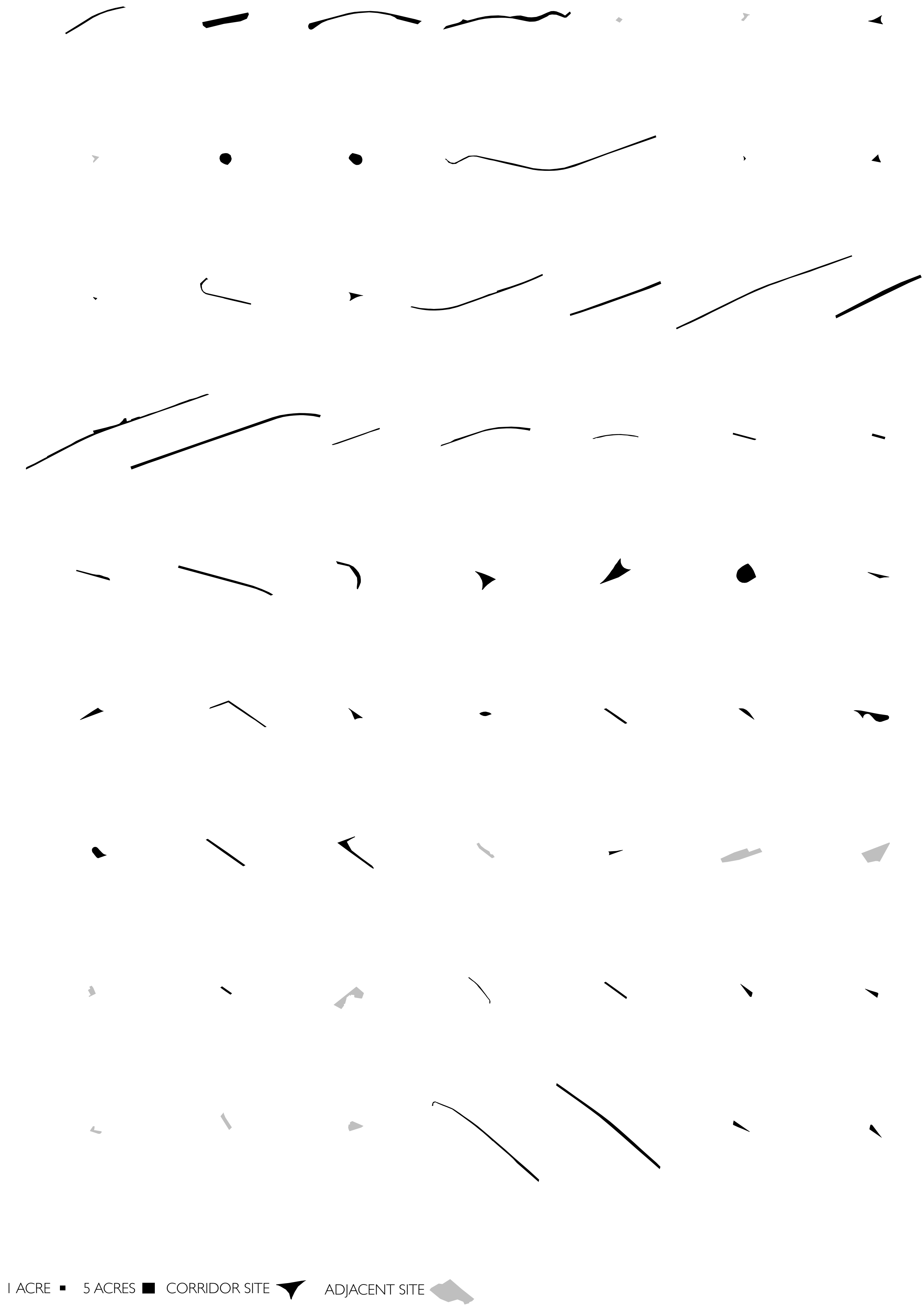

1 ACRE
5 ACRES
CORRIDOR SITE
ADJACENT SITE

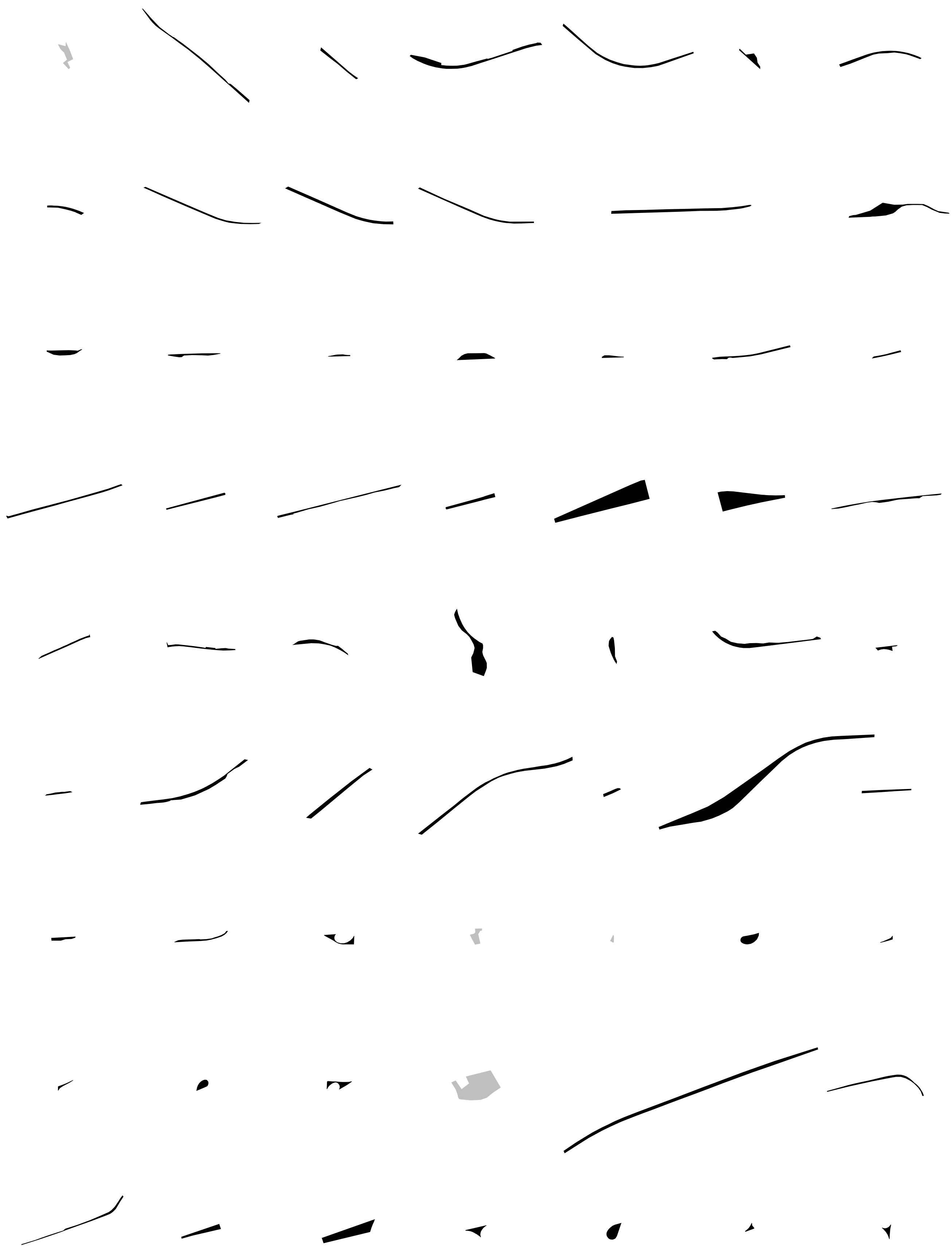


1 ACRE ▪ 5 ACRES ■ CORRIDOR SITE ADJACENT SITE

1 ACRE 5 ACRES CORRIDOR SITE ADJACENT SITE

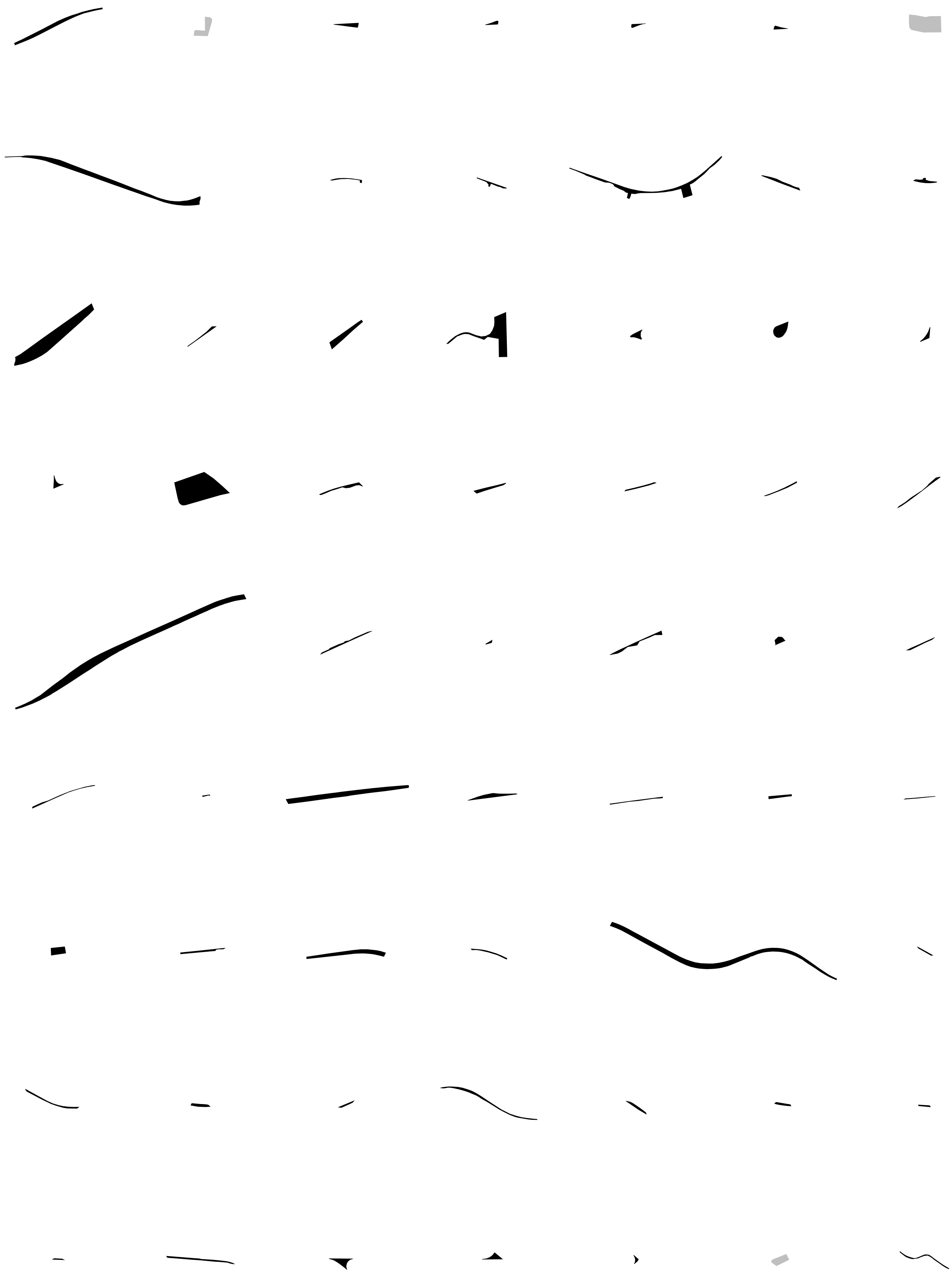

1 ACRE
5 ACRES
CORRIDOR SITE
ADJACENT SITE


1 ACRE
5 ACRES
CORRIDOR SITE
ADJACENT SITE

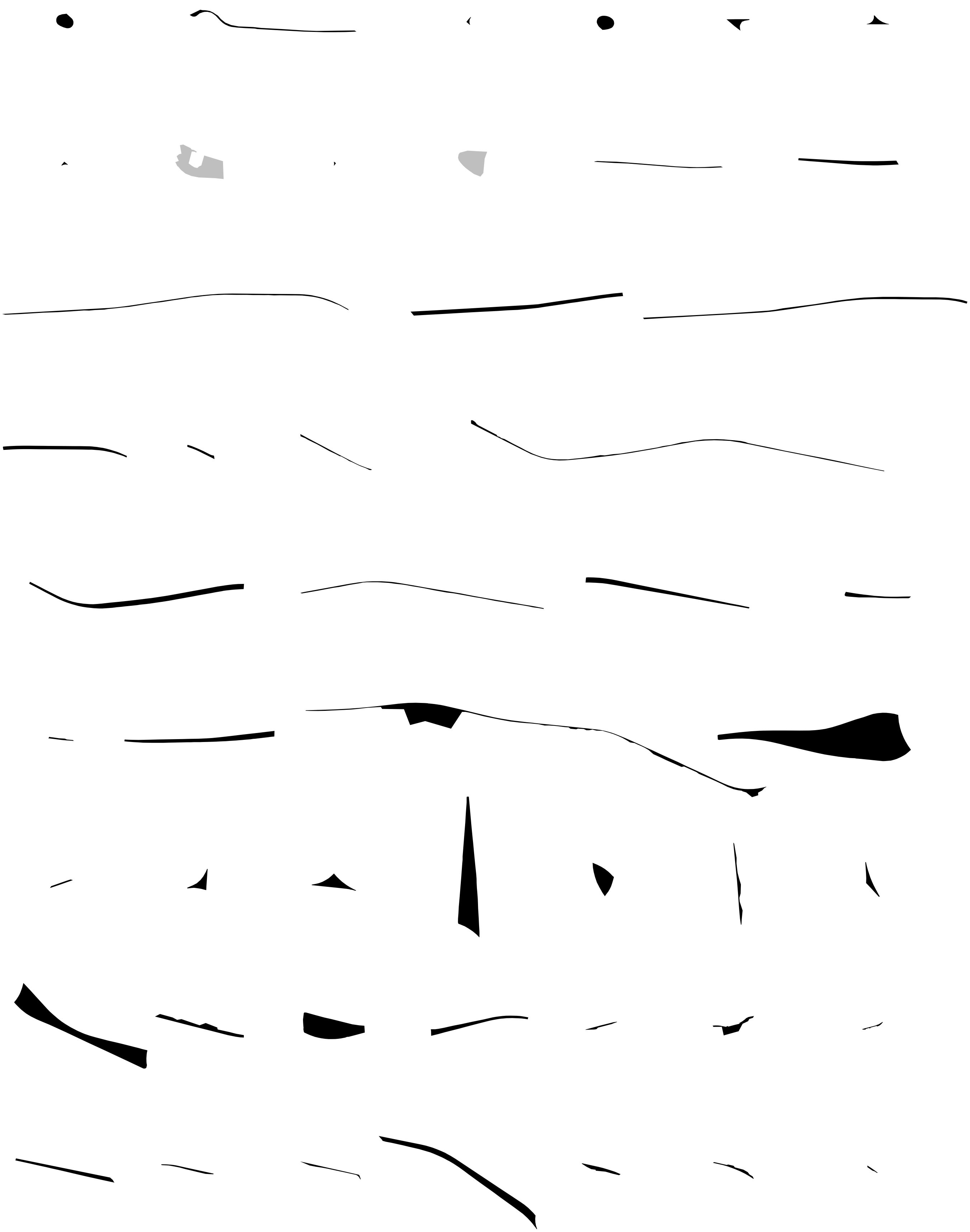


1 ACRE ▪ 5 ACRES ■ CORRIDOR SITE ADJACENT SITE

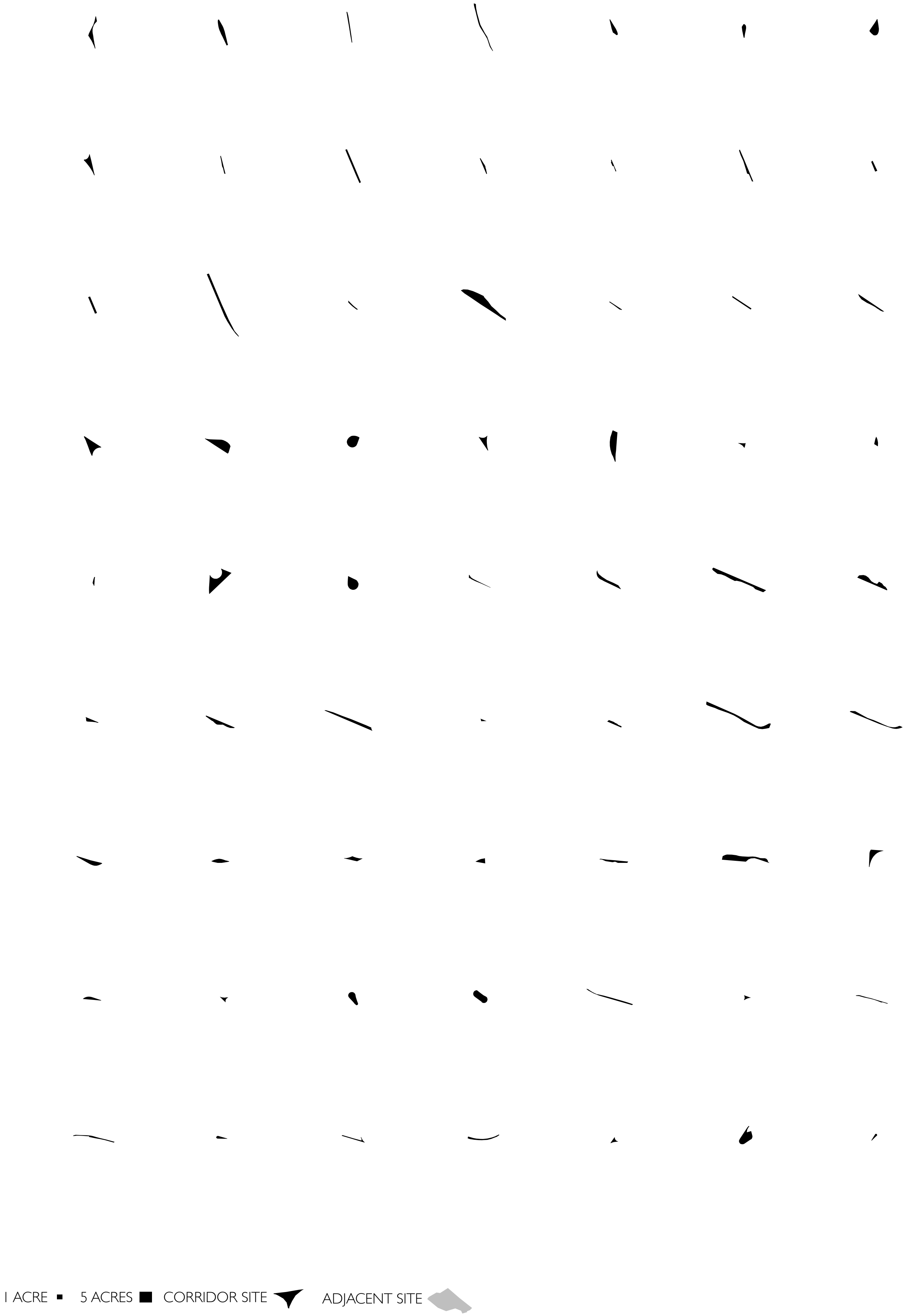

I ACRE
5 ACRES
CORRIDOR SITE
ADJACENT SITE



1 ACRE ■ 5 ACRES ■ CORRIDOR SITE ADJACENT SITE



1 ACRE
5 ACRES
CORRIDOR SITE
ADJACENT SITE

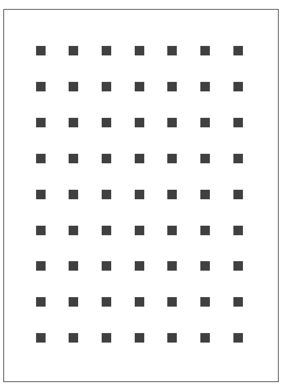

1 ACRE
5 ACRES
CORRIDOR SITE
ADJACENT SITE

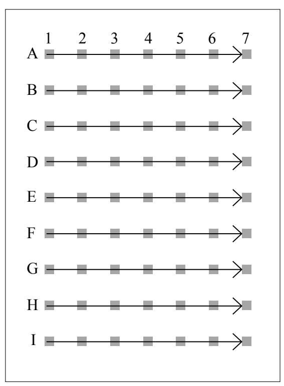
1 ACRE ▪ 5 ACRES ■ CORRIDOR SITE ADJACENT SITE

Appendix E:

Norfolk Southern Railway Eastern Division Grid Site Catalog

Sites along the Norfolk Southern Railway Eastern Division have been removed from their spatial order and rearranged in a 7 x 9 grid. Sites are placed in the grid with the first site at the top of the first page as the western-most site along the corridor. Each column moves progressively along the corridor. As shown in the diagram below, each row starts on the left edge of the paper. Reading the sites from left to right, as reading a book, provides an approximate west to east reading of the corridor. When a site was too large to be accomodated in the grid, it was given more than its alloted space, displacing later sites.





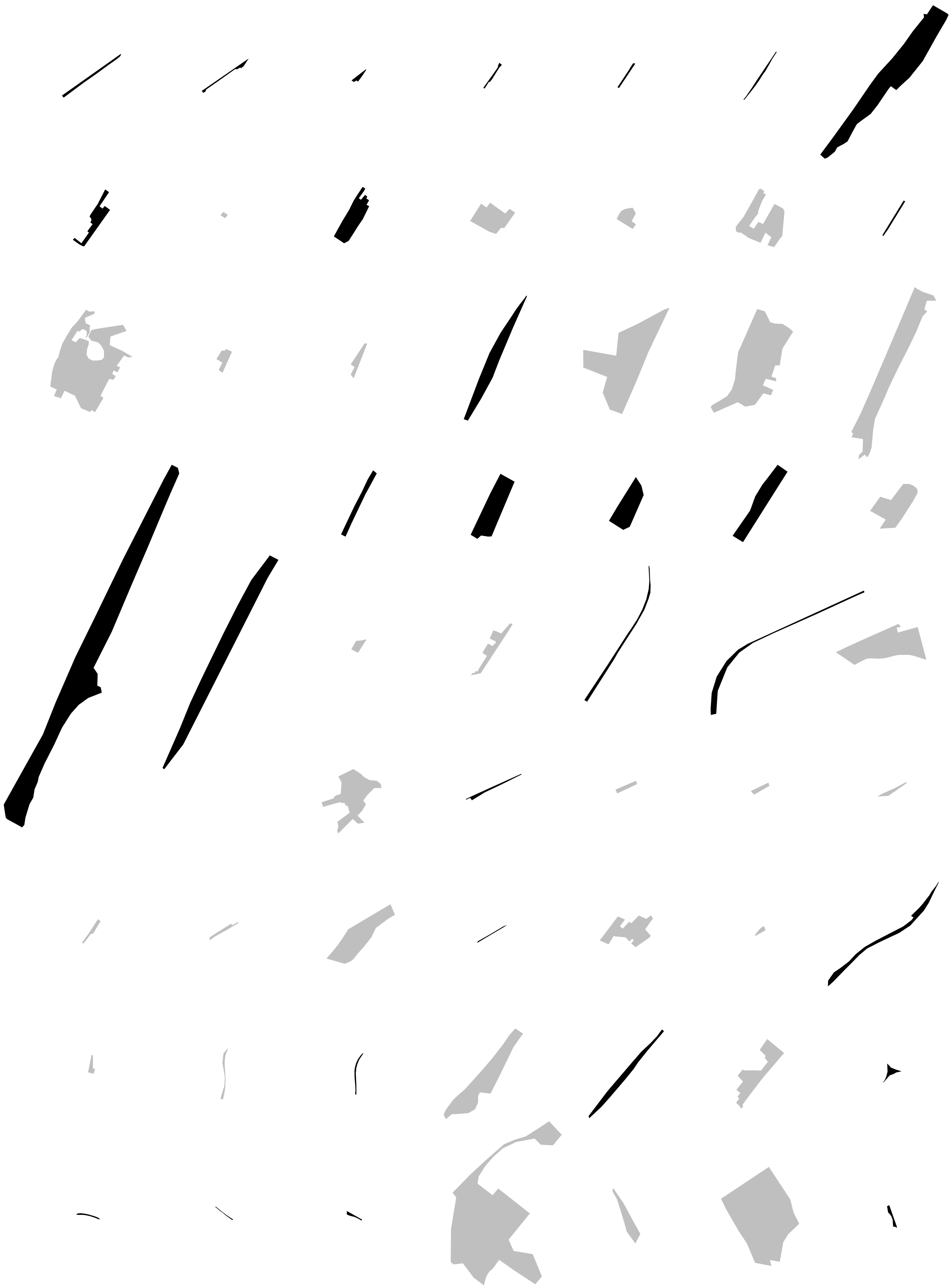
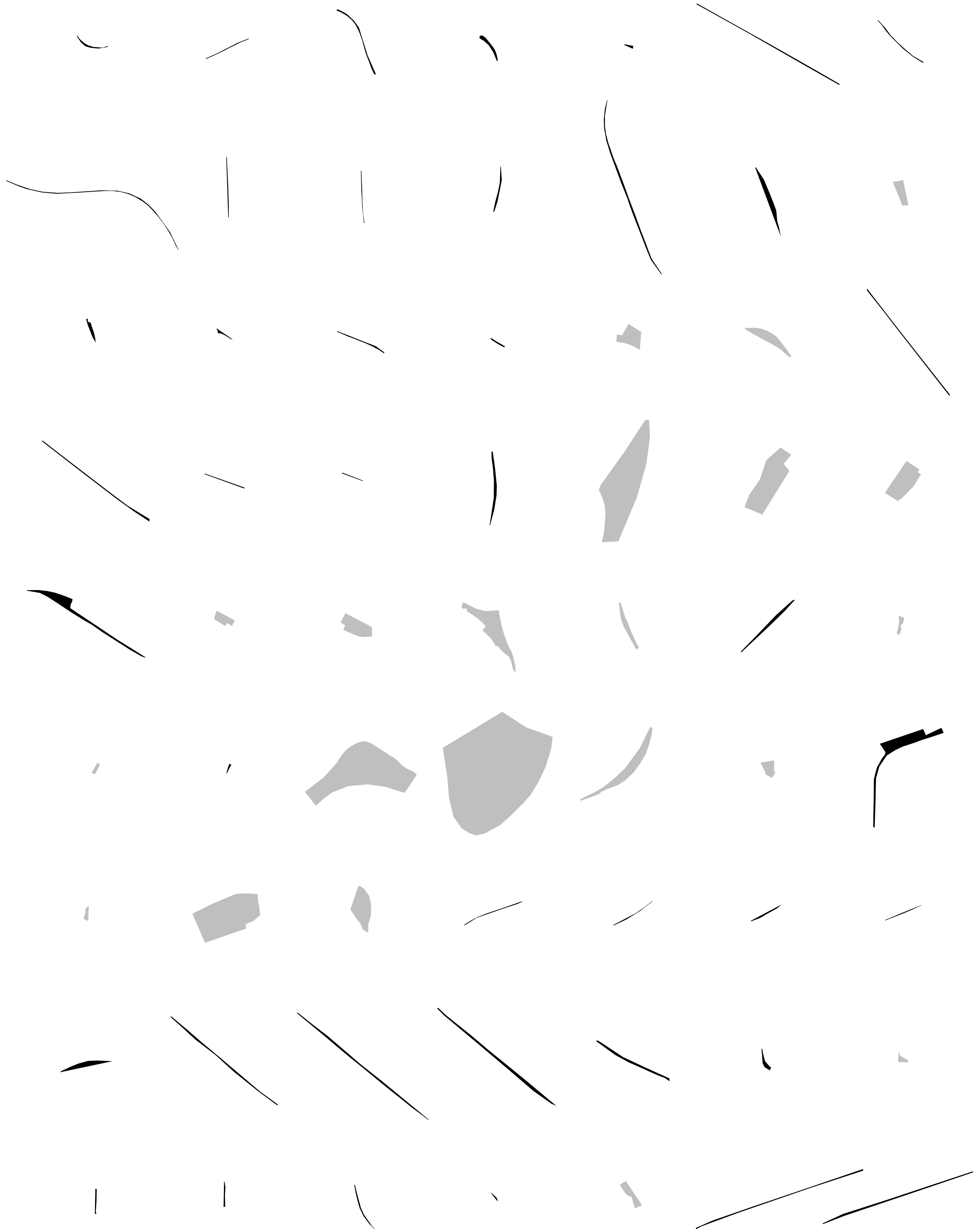
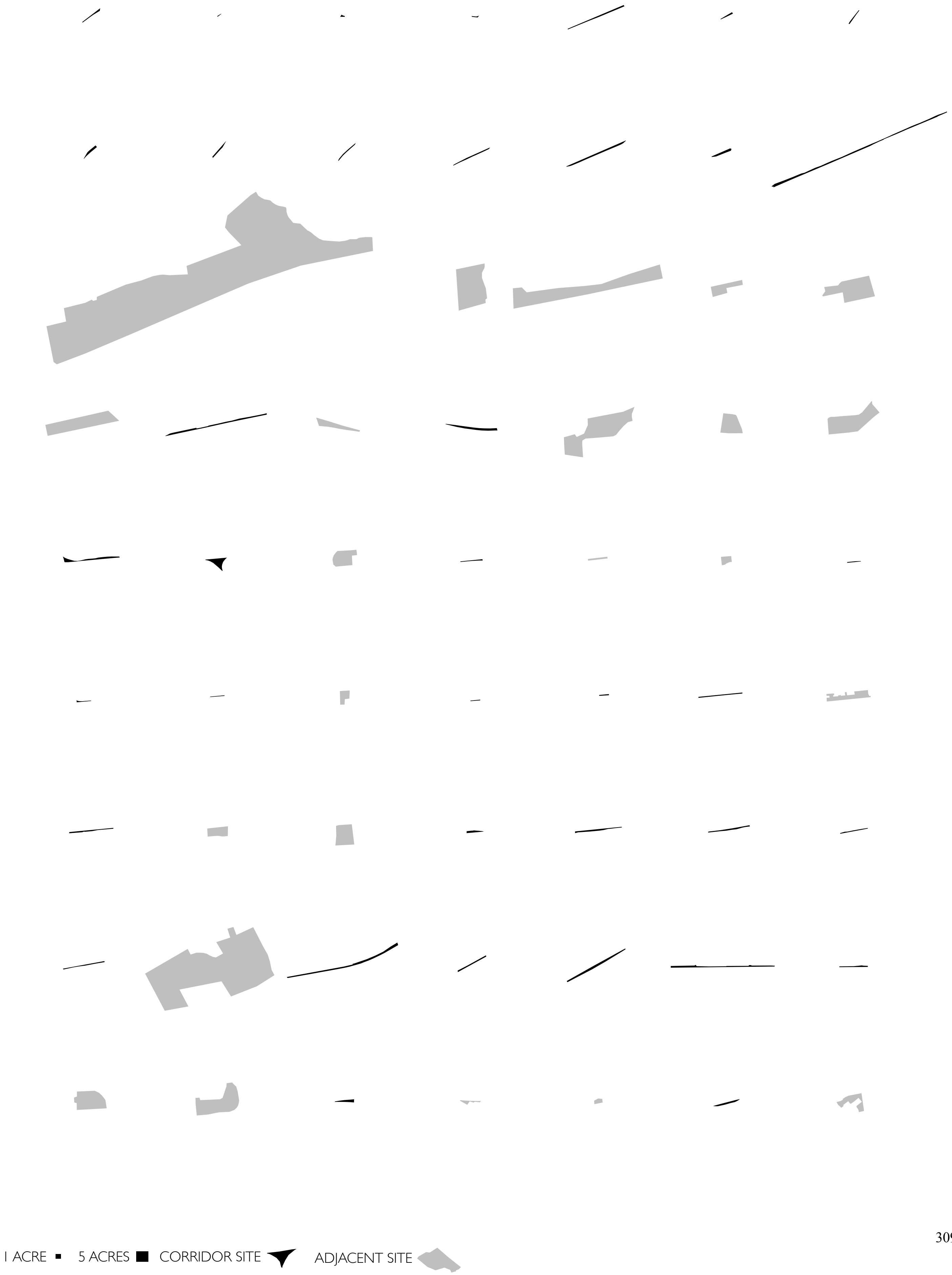


Figure 96 Norfolk Southern Railway Eastern Division Grid Site Catalog



I ACRE ▪ 5 ACRES ■ CORRIDOR SITE ADJACENT SITE


1 ACRE
5 ACRES
CORRIDOR SITE
ADJACENT SITE


I ACRE
5 ACRES
CORRIDOR SITE
ADJACENT SITE


1 ACRE
5 ACRES
CORRIDOR SITE
ADJACENT SITE

1 ACRE   5 ACRES   CORRIDOR SITE   ADJACENT SITE

Appendix F:

Susquehanna-Roseland Grid Site Catalog

Sites along Susquehanna-Roseland have been removed from their spatial order and rearranged in a 7 x 9 grid. Sites are placed in the grid with the first site at the top of the first page as the western-most site along the corridor. Each column moves progressively along the corridor. As shown in the diagram below, each row starts on the left edge of the paper. Reading the sites from left to right, as reading a book, provides an approximate west to east reading of the corridor. When a site was too large to be accomodated in the grid, it was given more than its alloted space, displacing later sites.

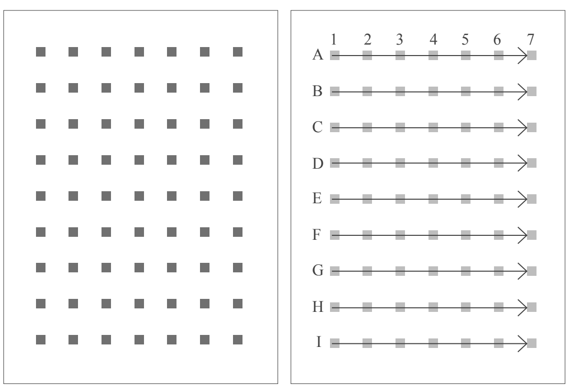
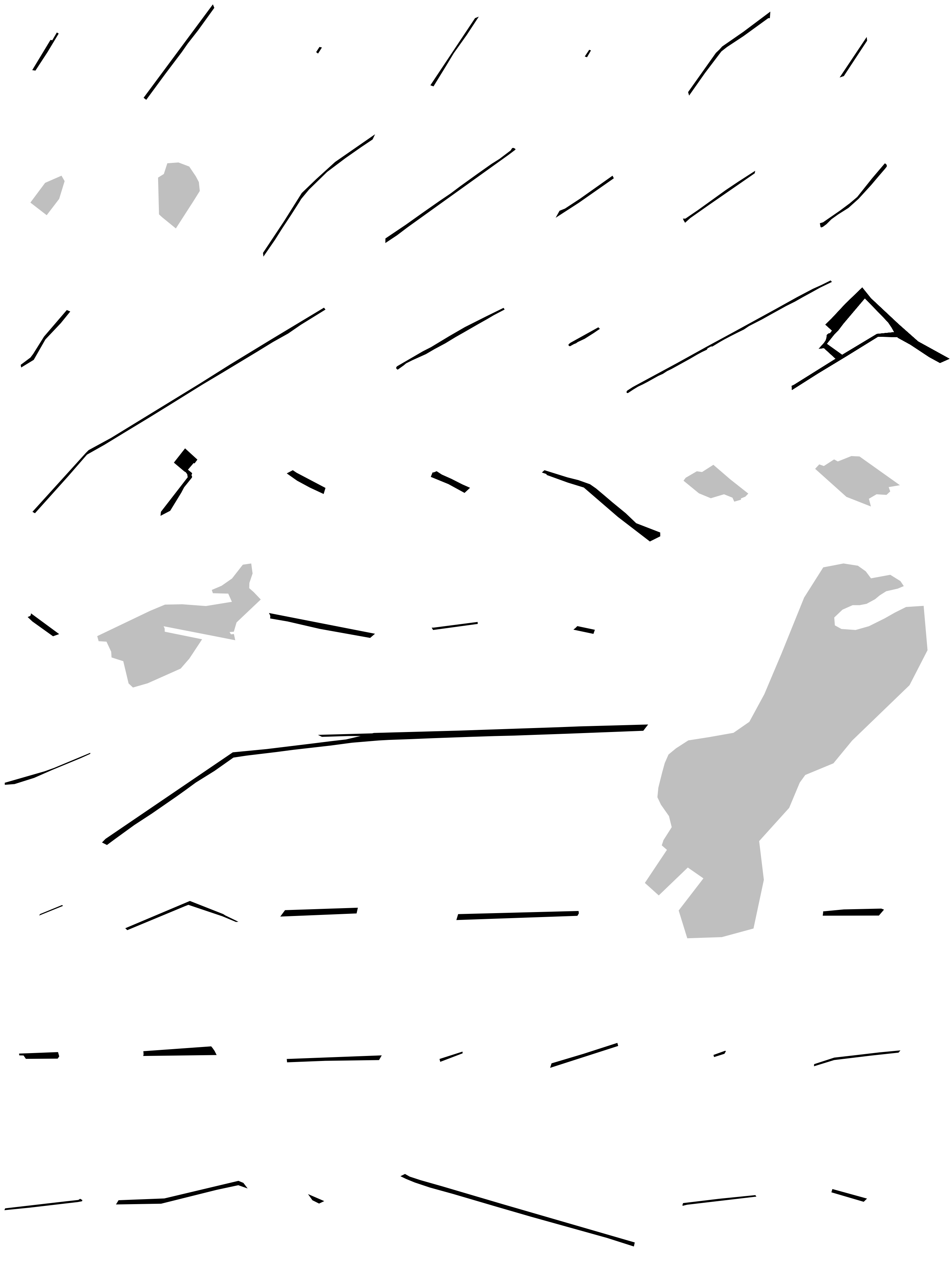


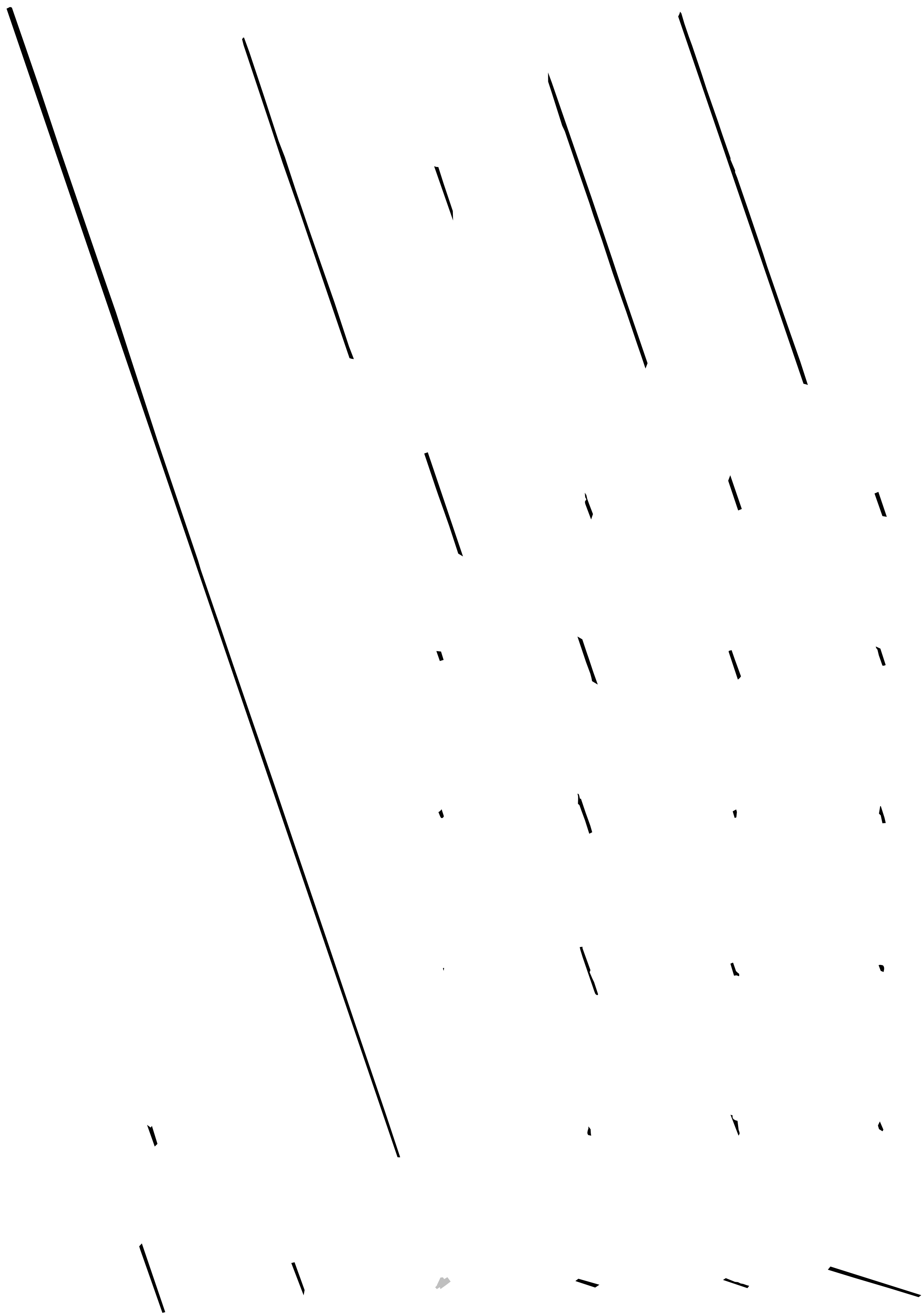
Figure 97 Susquehanna-Roseland Electric Transmission Line Grid Site Catalog

1 ACRE ▪ 5 ACRES ■ CORRIDOR SITE ADJACENT SITE



1 ACRE
5 ACRES
CORRIDOR SITE
ADJACENT SITE

1 ACRE ▪ 5 ACRES ■ CORRIDOR SITE ADJACENT SITE



1 ACRE ▪ 5 ACRES ■ CORRIDOR SITE ADJACENT SITE