PROJECT VUE: VISUALIZING URBAN EQUILIBRIUM

by

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A REPORT

submitted in partial fulfillment of the requirements for the degree

MASTER OF LANDSCAPE ARCHITECTURE

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College of Architecture, Planning, and Design

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Abstract

Visualizing Urban Equilibrium is a landscape architecture master's project and report intended to enhance the collective hydrologic, social, and aesthetic functions of Kansas State University's Campus Creek corridor. The highly urbanized conditions of the approximately 1.4 mile channel and 408 acre sub-watershed are the result of neglect for stable hydrologic function, poor campus planning, and a disregard for cohesive form and function of natural aesthetics on campus.

This proposal aims to balance goals of enhanced hydrologic function with those of campus social and aesthetic function into one cohesive process of landscape planning and design. Synthesizing complex social fabrics with proper urban watershed assessment and management, as well as natural geomorphic channel design re-envisions of sense of harmony and place within a major campus corridor and green space. Communication of this proposal takes the form of a Comprehensive Campus Creek Corridor Plan, for a rapidly developing academic institution and community.

This plan centralizes the creek on campus and includes urban-watershed assessment, site specific conceptualizations of storm-water best management practices, and detailed channel enhancement for improved hydrologic function. Social function is enhanced through integration of pedestrian oriented planning, and education oriented spatial design opportunities for increased interaction with and within the Campus Creek corridor. Enhancement of aesthetic function includes management for a balance of formal and natural character, re-established visual connectivity and sense of place, as well as installation of landscape improvements and artistic expressions of the "equilibrium" paradigm defining the creeks natural function and its urban context. Included in this masters project and report is a project introduction and premise, Campus Creek site inventory and sub-watershed assessment, programming for improvements, and visualization of the conceptual comprehensive plan and site design elaborations.

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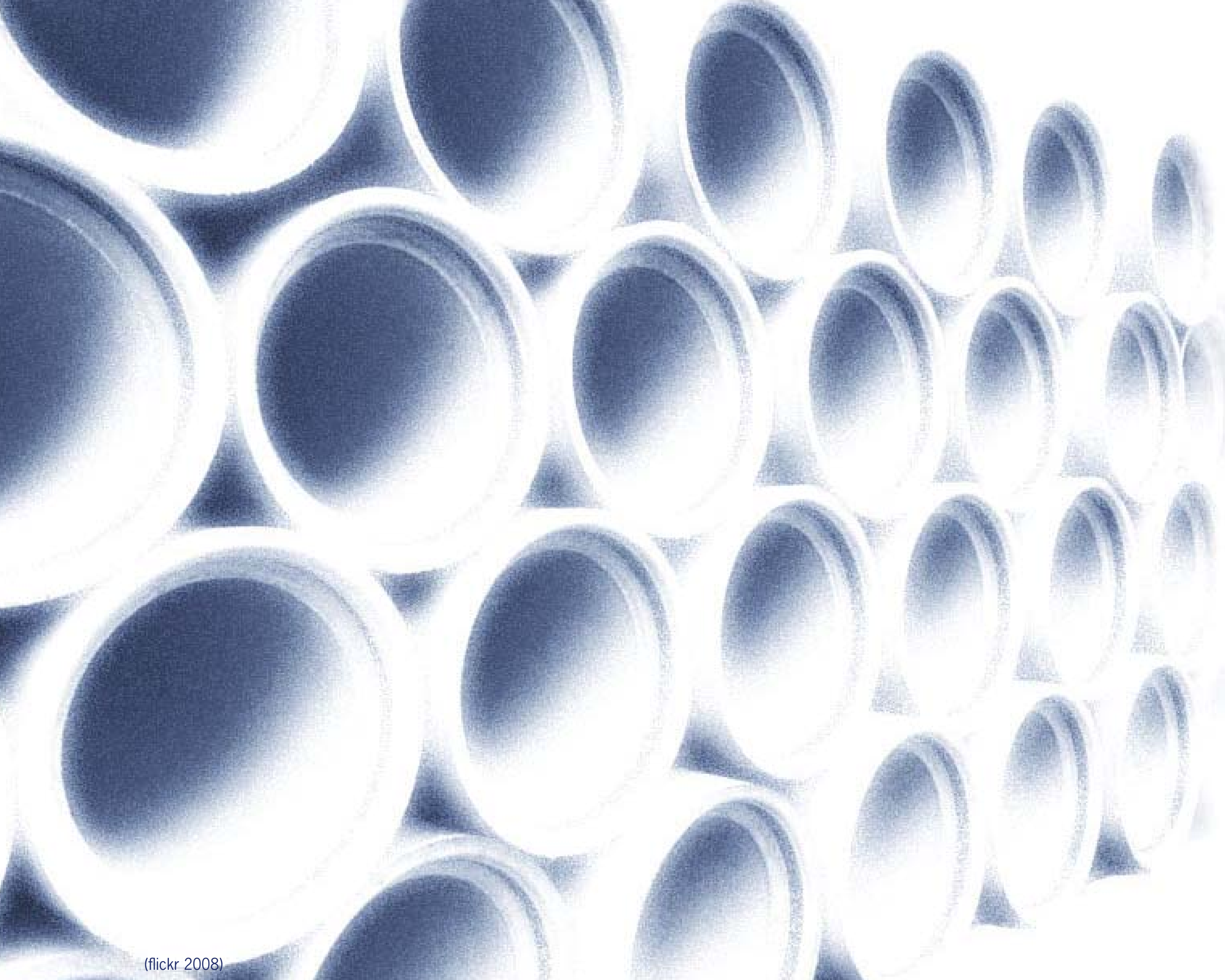
Project VUE

Visualizing Urban Equilibrium

Campus Creek Enhancement Planning & Design

Michael Brennan Meihaus

Front Cover (Meihaus 2008)



(flickr 2008)

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Title Information

Visualizing Urban Equilibrium

Campus Creek Enhancement Planning & Design

Masters Project and Report

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Premise

Dilemma

"As cities and metastasizing suburbs forsake their natural diversity, and their citizens grow more removed from personal contact with nature, awareness and appreciation retreat. This breeds apathy toward environmental concerns and, inevitably, further degradation of the common habitat" (Pyle 1993, 146).

– Robert Pyle

The schism between the **nature of humanity** and **humanity toward nature** is growing rapidly. Cities both large and small increasingly face the challenge of realizing a harmony between the needs of citizens and the necessities of natural local environments. Everywhere, even in Manhattan Kansas and especially at Kansas State University, exists the undeniable need to 'mind the gap'.

The proverbial 'gap' for many people living in urban areas are the tiny bits of nature which can be seen lingering in a forgotten landscape. A back yard or an abandoned lot, a small patch of green or an overgrown ditch hold and incredible potential to allow nature to creep back into the lives of urban dwellers. In the case of such academic institutions and communities as K-State, this alchemy of a relationship is exemplified on campus and in the form of a glorified drainage-way called Campus Creek.

Known conservationist Robert Pyle attributes increased apathy toward local environmental issues to an "extinction of experience" in his book *The Thunder Tree* (Pyle 1993). Pyle's description of people's alienation from nature, accompanied by his own tale of discovering natural beauty in the most unlikely of places, exemplifies the root of the problem at hand. Lingering on the fringes of society and within the cracks of the urban landscape are the hints of once pristine, wild, biologically diverse and ecologically stable places we call nature.

"These are the places of initiation, where the borders between ourselves and other creatures break down, where the earth gets under our nails and a sense of place gets under our skin. They are the secondhand lands, the hand-me-down habitats where you have to look hard to find something to love" (Pyle 1993, xvii).

– Robert Pyle

These "secondhand lands" are woven into the urban landscape all around us, and within this alchemy is the potential for an intimate and incalculable relationship with these artifacts of the natural environment (Pyle 1993, p. xix). A humble place at Kansas State University called Campus Creek exhibits this dilemma of disregard for the very essential pieces of nature which are left only to eventually disappear entirely within our midst. There is a gap between the hydrologic function of the creek, and the social and aesthetic function of the campus. Campus planning, design, landscaping, land-use and management all directly impact the creeks ability to form physically stable channel and floodplain dimensions. One operation exists without recognition of the other or not at all, and both the creek and the campus suffer physically for this imbalance.

The dilemma is how to integrate proper watershed management and natural channel enhancement strategies for urbanized streams such as Campus Creek. The current remains of the creek hold the potential for a re-established identity and purpose on K-State's campus. This potential lies in the concept of a state of physical ‘equilibrium’ of hydrologic, social, and aesthetic function.

“The problem then, is how to bring about a striving for harmony with land among a people many of whom have forgotten there is any such thing as land, among whom education and culture have become almost synonymous with landlessness” (Leopold 1970, 210).

– Aldo Leopold

The initial problem confronting a stream enhancement project is defining to what historically natural condition, or to what level of “urban equilibrium” could and should a stream system be restored. The status of degradation and urbanization in which a stream currently exists constrains the feasibility of restoration, and the will help define restoration objectives suitable for specific projects (Riley 1998, 27). Human built history, in this sense, is as important as ecological history.

Ann Riley defines ecological restoration as, “the process of intentionally compensating for damage by humans to the biodiversity and dynamics of indigenous ecosystems by working with and sustaining natural regenerative processes in ways which lead to the re-establishment of sustainable and healthy relationships between nature and culture” (Riley 1998, 27). In the case of urban streams, the focus is physical characteristics of a stream and its ability to function hydrologically.

Returning the once naturally occurring physical features to a degraded stream will afford it the best chance for a balance of function hydrologically, and in turn ecologically and biologically. Riley describes this balance as “urban equilibrium”, or “a channel that has changed from its natural or original shape but has finished adjusting to the urban influences affecting it so that it is relatively stable in its plan form and meander and has achieved a new balance in its bank-full width and depth, so that it is neither excessively eroding nor depositing and has healthy riparian growth” (Riley 1998, 410).*

Urbanized creeks are the result of urbanized watersheds. Development within a watershed inevitably causes the degradation of the channel which carries its waters, in turn compounding the adverse channel effects back to the urban watershed (Figure 01). Changes in land use and or the management of water characterize the urbanization of a watershed, and are the culprits of imbalanced systems. Urbanization tends to cause a loss of native vegetation and wildlife habitat, connectivity among channels, reduction of water quality, changes in watershed hydrology, increase in run-off, increased velocity of run-off, and urban pollution from sediments and other contaminants (Riley 1998, 129).

The complexity of urban watersheds is increased with physical alterations to once natural hydrological cycles. The worst modification to the hydrology of a watershed is the consignment of creeks and stream systems to impervious surface materials, culverts, pipes, and storm-water systems completely eliminate all natural features and function (Figure 01). Floodplains, arguably the most biologically and hydrologically productive feature of a natural system, are completely separated or destroyed. Along with floodplains dissolves riparian vegetation, a loss of habitat, nutrients, soil and stream bank stability, shade, and balance of sediment supply. All of these complex problem are present to some degree on Campus Creek (Figure 02).

Another major by-product of urban development is an increase in impermeable surface cover and therefore increased storm-water run-off (Figure 01). Increase in run-off results in greater volume of peak flows within the urbanized watershed (Riley 1998, 132). These new peak storm flows are complimented by low dry season flows, disabling the systems ability to maintain equilibrium. Urban increase in flows carry and deposit increased amounts of sediment into the system. Increased sedimentation creates imbalance in both the physical properties of a stream as well as being the major source of water quality degradation.

The adverse effects of urban development stated above are the result of poor watershed management and an ignorance of monitoring changes to natural systems with continued urbanization. The result of neglecting proper watershed management are changes to stream channels requiring control of rapidly emerging erosion and flood conditions, and water contamination which often pose public health and safety concerns (Figure 02). The reactionary health concern of the inhabitants of these degraded watersheds is reflected in the degraded ecological and biological health of urbanized streams (Riley 1998, 129). The forms created by this relationship are ultimately ones without any sense equilibrium between the urban and the natural.

The response of streams to urbanization of their respective watersheds can be seen as a cycle of stream channel degradation (Figure 03). Natural streams experience new development, increased sediment and higher discharges and velocities, decrease sediment deposition in relation to discharge, causing channel enlargement and erosion, and eventually settle into a state of quasi-equilibrium with surrounding urban influences. Gradients and meanders are also altered and unable to fluctuate independently

Figure 01 - Campus Creek Dilemma Photography (Meihaus 2008)

of human influence. Streams continue to create incisions, gullies, and other changes in grade from constant negative impacts of the urban environment and an inability to achieve the equilibrium once established (Riley 1998, 137).

Philosophy

> "We shall never achieve harmony with land, any more than we shall achieve absolute justice or liberty for people. In these higher aspirations the important thing is not to achieve, but to strive" (Leopold 1970, 210).
>
> - Aldo Leopold

Before manipulating the landscape or attempting to judge which changes are right and which ones are wrong, one must first be humble and marvel at the complexity of the land organism. Not even the most advanced science can unveil all of the Earth's intricacies for the human mind to see it so holistically and absolutely as to make the perfect decision upon the fate of the land. Harmony in this sense between man and nature is not an achievable goal. Harmony, rather, is an ideal powerful enough to strive for despite admittance of our incapacity to understand it completely.

> "Like all real treasures of the mind, perception can be split into infinitely small fractions without losing its quality" (Leopold 1970, 292).
>
> - Aldo Leopold

The goal is the perception of harmony itself, and pursuit of the concept to the best of our intellectual and technological ability. Success is immeasurable as a perfect equilibrium between humans and the land organism we occupy. Success, rather, is visualizing an idea of equilibrium as a means progressing toward it. The dilemma is first how to raise an awareness of the land itself where

Figure 02 - Campus Creek Adjustments to Urbanization (Meihaus 2008)

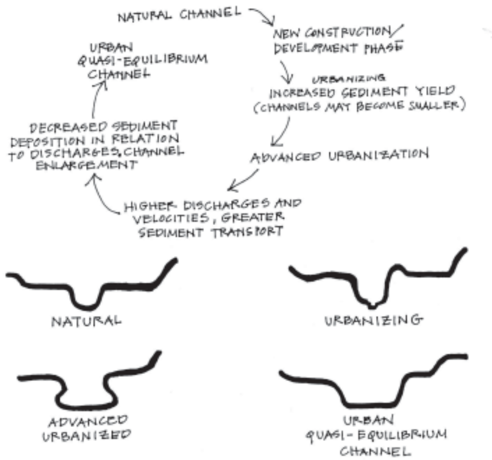


Figure 03 - Typical Cycle of Stream Channel Adjustments to Urbanization (Riley, 1998)

it has been forgotten, and second to teach the perception of harmony and equilibrium with the land.

Relevancy

As described by Ann Riley, "we all live in a watershed" (Riley 1998, 1). Understanding this is the first step toward the stewardship of every watershed and to utilizing a local stream as a public amenity instead of a constant nuisance and safety concern. This simple change in perspective requires an interdisciplinary approach to solving the problem (Figure 04).

The problem, as it is identified by Riley, is the conventional, destructive, and expensive means of managing public works (Figure 05). Her book, Restoring Streams in Cities, focuses on identifying, restoring, and managing the physical attributes of a stream (Figure 06): shape, bank stability, floodplain connection, meandering, pools, riffles, and riparian vegetation (Riley 1998, xix). With physical function improved, so follow improved water quality, biological function, and socioeconomic benefits (Figure 07). Involving fields of design, namely landscape architecture, in the process of stream restoration is a means of exploring the imagination and exploring innovative ways to create equilibrium between the urban mosaic and the physical, hydrological, processes and functions of the streams lying between and beneath.

Riley takes the "audience cognizant" approach to introducing the basics of stream restoration; including a wide range of knowledge and delivering it to an even wider range of readers. Stream restoration is first described as a "complicated business" requiring the input and consideration of regularly conflicting ideas, practices, and interests. These conflicts arise in the economic,

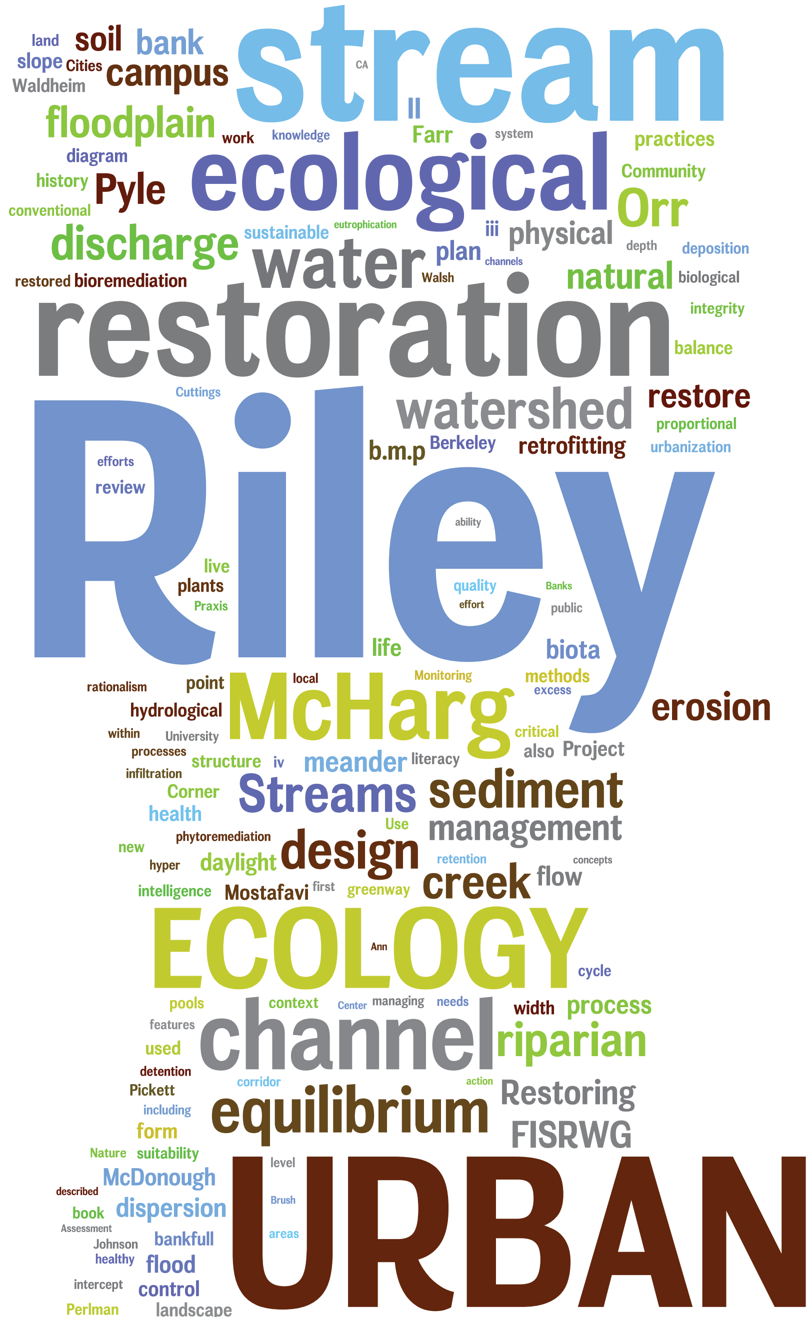


Figure 04 - Literature Map (Meihaus 2008)

political, professional, and social realms, not to mention the inherent conflict between urban development and natural processes of the local landscape. Urban stream restoration is uniquely visible to the public, and therefore popular, with the ability to capture people's interests and imagination (Riley 1998, xviii). Community involvement and social interaction with a local stream are critical for gaining support and making a solid argument for restoration efforts. Economics aside, the greatest value found in a stream corridor and its restoration may be a sense of community pride and participation (Riley 1998, 8).

The public places a certain inherent value on the recognition of natural resources within their respective community. These values extend to ecology, education, interaction and contact with nature, regional and local identity, as well as aesthetic preference and quality of form. Communities, by in large, have a level of awareness their urban areas are becoming increasingly devoid of a connection to natural edges, paths, and places. Alienation from natural environments and a loss of intimacy with the living world outside of our own species can be detrimental to communities and especially to children. "The extinction of experience" as described by Robert Pyle, is the loss of a sense of geographic place and a deprivation of healthy minds and emotional states (Pyle 1993). This perspective suggests the creeks we live close to, as a natural phenomenon, are as important to our senses, minds, and health as they are to the hydrological and ecological processes in which they are sustained.

"To learn of the evolution of physical and biological processes is an indispensable step towards the knowledge one needs before making changes to the land: but it is far from enough" (McHarg 1969, 96).

- Ian McHarg

Figure 05 - Urbanization Photography (Meihaus 2008)

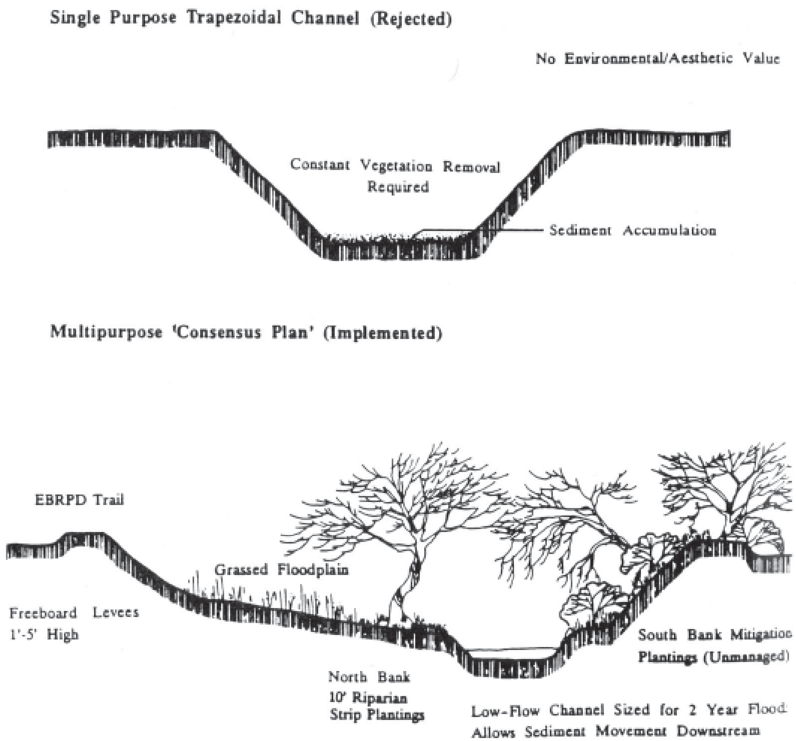


Figure 06 - Trapezoidal versus Naturalized Channel (Riley 1998)

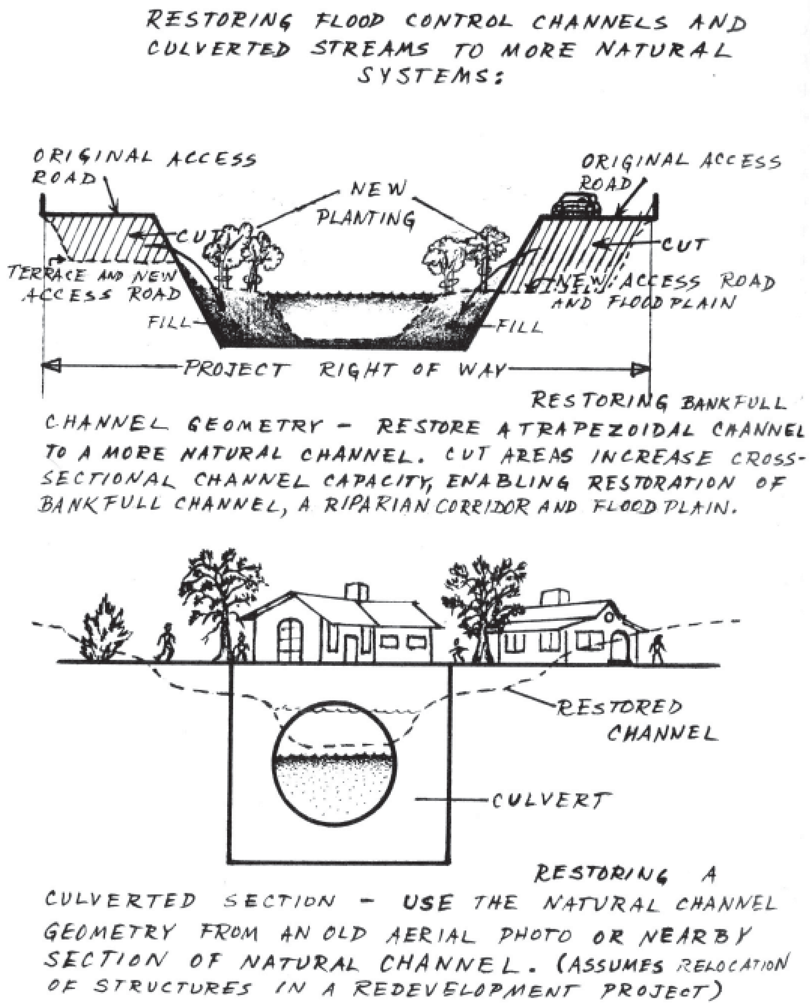


FIGURE 7.7. RESTORING FLOOD-CONTROL CHANNELS AND CULVERTED STREAMS TO MORE NATURAL SYSTEMS.

Place

Site Location

Campus Creek is located on the Kansas State University campus proper, in Manhattan, Kansas. The creek is defined in the south by its outfall beneath N. Manhattan Avenue, and in the north and west by its upper reaches which extend to Denison Avenue and disappearing just beyond the Veterinary Medicine Campus (Figure 08).

The length of the channel slated for improvement within this proposal is approximately 7200 feet, or 1.4 miles, and the Campus Creek sub-watershed is about 408 acres.

Brief History

Background information regarding the history of the creek is limited. Most information about the creek's past is interpolated from general land-use trends of the university campus and the greater manhattan area.

Historically, Kansas State University is an agricultural school. Most of the land surrounding the creek were pastures and farmland, as seen in the 1885 Kern Plan (Figure 09). Rapid development of the campus and city of Manhattan followed, and urbanization of the creek ensued. Based only on historic maps and sketches produced since the 1870's, the general alignment of creek does not appear to have changed significantly. The ostensible purpose of the small pasture channel shown in Figure 09 is simply a drainage ditch.

This historical function differs from the current function only in the type of land use for which the creek is intended to convey water off of and eventually into the Kansas River. The Kern Plan also depicts signs of vegetation

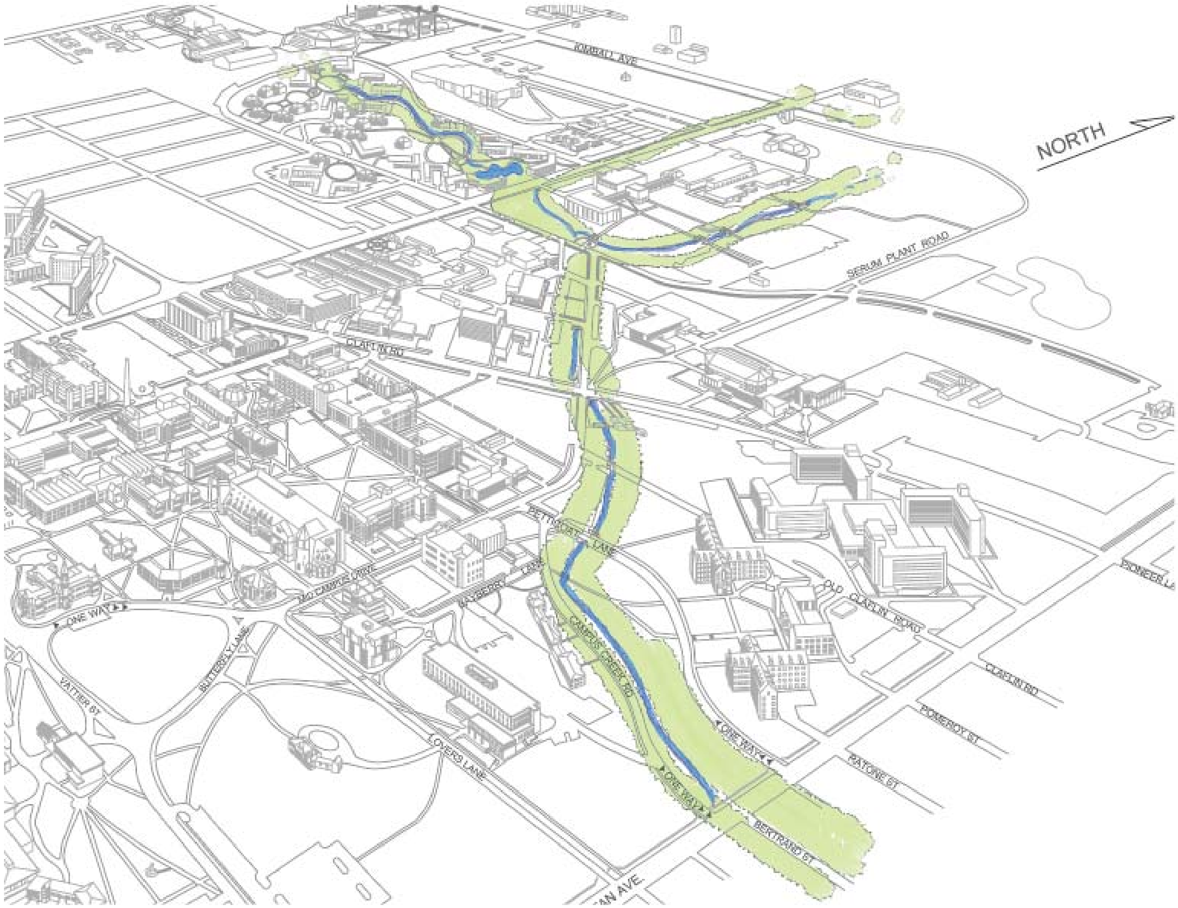


Figure 08 - Current Campus Creek Location Map (KSU 2007)

and tree canopy, analogous with the area of the creek that exhibits similar mature woody vegetation today.

Some of the only other information gathered regarding the history of Campus Creek are a few sketches by Emil C. Fischer, former Dean of the College of Architecture Planning and Design. His illustrations of the Vet. Med. Complex, Jardine Terrace Apartments, and Home Management Houses depicts slivers of the creek (Figure 10). These slivers show a slightly different character seen along the creek today. Fischer's illustrations depict a less vegetated channel in terms of both mature trees and in general overgrowth of shrubs (Figure 10). The sketches do show, however, the same pedestrian bridges in front along Campus Creek Road and south of the Vet. Med. Complex, as well as the same box culvert outlet structure along Denison Avenue (Figure 11).

Today the campus is fully developed (Figure 08), or urbanized, and delivers run-off to the creek directly via storm-water pipes as opposed to mere surface drainage. The process of urbanization of Campus Creek is typical of most streams in urban areas, the difference is the amount of potential the Campus Creek has within the context of Kansas State University (Figure 11).

Complete characterization of the existing campus within the sub-watershed of Campus Creek is included in the Inventory and Assessment Chapter.

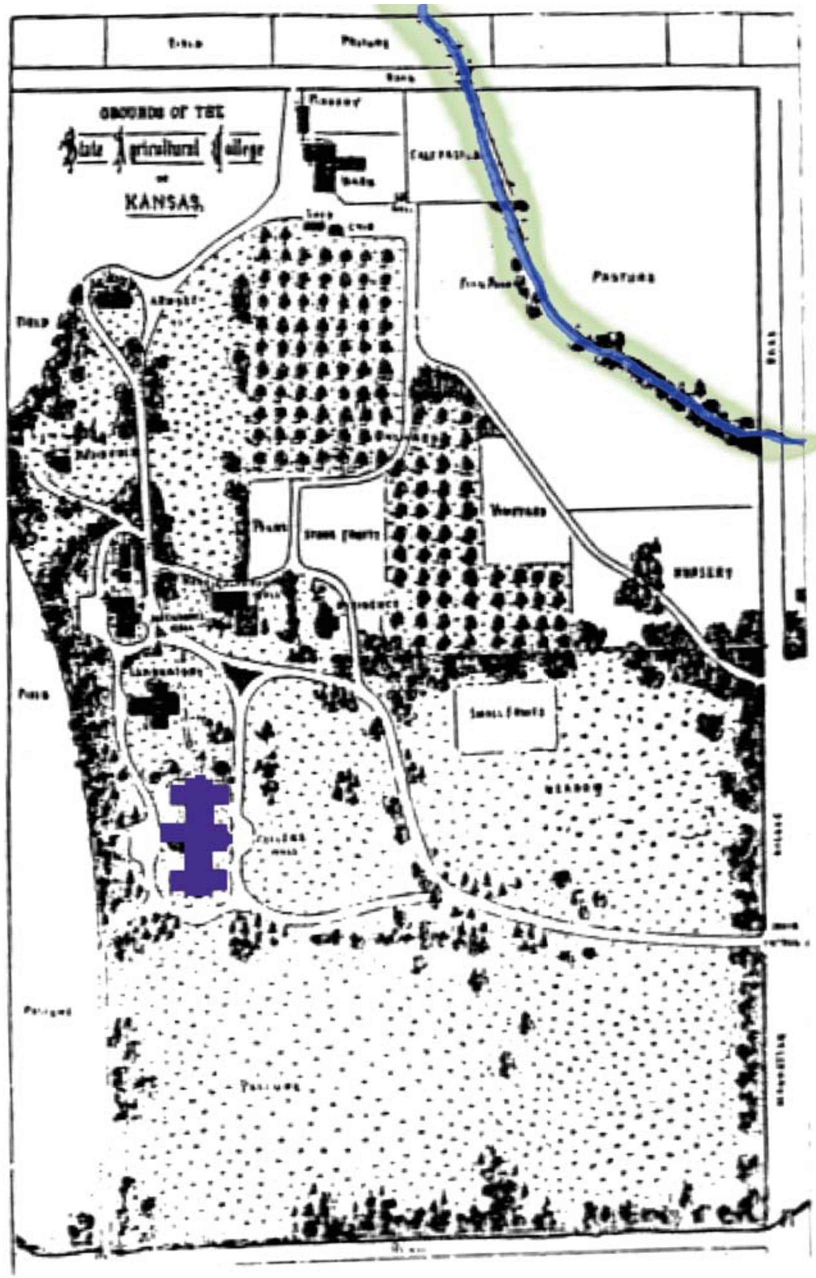


Figure 09 - KSU Campus, 1885 Kern Plan (Tolliver 1996)

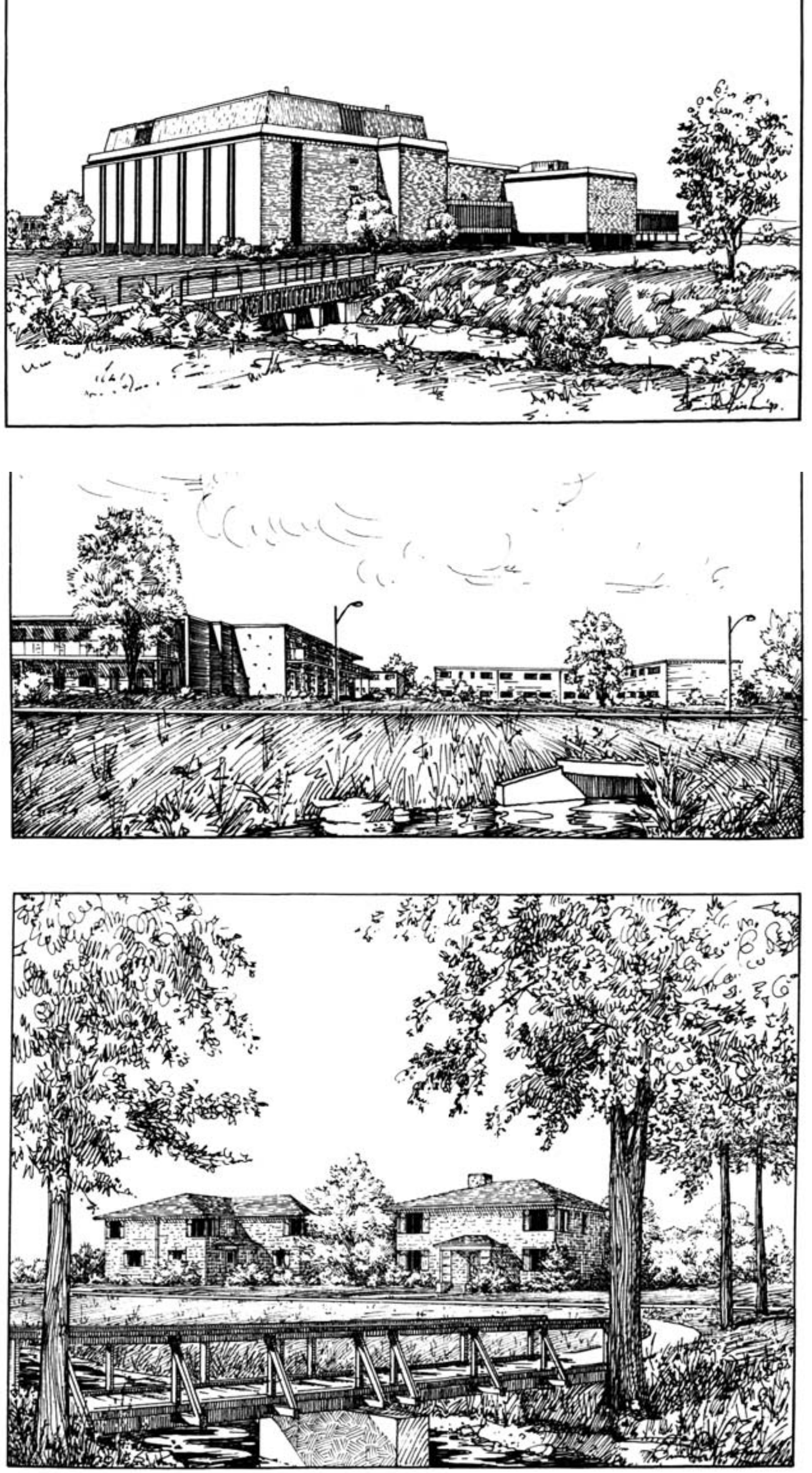


Figure 10 - Emil C. Fischer Campus Illustrations (Fischer 1992)

Figure 11 - Site Photography Typical (Meihaus 2008)

Proposal

Thesis

Visualizing Urban Equilibrium intends to illustrate how hydrologic, social, and aesthetic enhancement of Kansas State University's Campus Creek and corridor could look and function collectively as an alternative perception of landscape planning and design.

Goals & Objectives

Enhance Hydrologic Function

1. Remove and substitute for past, present, and future development directly impacting hydrologic function of the watershed, channel, and floodplain.

2. Manipulate and re-create three dimensional stream channels for physically stable form and naturalized hydrologic function.

3. Retro-fit urban storm water best management practices for current and future impervious areas contributing excess run-off affecting hydrologic function of the urban watershed and physical stability of the channel.

4. Establish and manage a channel buffer zone and proper floodplain corridor for both native riparian and wet-mesic prairie vegetation respectively.

Enhance Social Function

1. Improve pedestrian and bicycle circulation experience laterally and transversely by way of the Campus Creek corridor.

2. Increase social activity for general campus interaction and academic utility including opportunities for small gatherings within the campus creek corridor.

Enhance Aesthetic Function

1. Prescribe a balance of natural and formal character, visual connectivity, and a sense of place for identifying with the Campus Creek corridor.

2. Manage the corridor for minimal turf-grass open space, non-invasive woody species providing overhead canopy, and suitable wet-mesic prairie vistas.

3. Instill an environmental sensitivity toward Campus Creek through artistic expression of urban hydrology, form, and function.

"The government tells us we need flood control and comes to straighten the creek in our pasture. The engineer on the job tells us the creek is now able to carry off more flood water, but in the process we have lost our old willows where the owl hooted on a winter night... Hydrologists have demonstrated that the meanderings of a creek are a necessary part of the hydrologic functioning. The flood plain belongs to the river. The ecologist sees that for similar reasons we can get along with less channel improvement on Round River" (Leopold 1970, 197).

– Aldo Leopold

"There is yet no social stigma in the possession of a gullied farm, a wrecked forest, or a polluted stream, provided the dividends suffice to send the youngsters to college. Whatever ails the land, the government will fix it. I think we have here the root of the problem" (Leopold 1970, 202).

– Aldo Leopold

"Our ability to perceive quality in nature begins, as in art, with the pretty. It expands through successive stages of the beautiful to values as yet uncaptured by language" (Leopold 1970, 102).

– Aldo Leopold

Proposal

Approach & End Product

Project VUE is centralized around the hydrologic enhancement of Kansas State University's Campus Creek. Preceded by the work of hydrologists and urban stream restoration professionals, namely Ann Riley, this project intends to visualize Riley's paradigm of "urban equilibrium". While Riley's definition of the term refers to the physical hydrologic function and stability of a stream in balance with its urbanized context, the idea is rooted in principal theories such as those of "harmony between men and land" from the works of Aldo Leopold and the like (Figure 12).

Stream enhancement together with landscape architecture means an entirely new world of knowledge and an inexhaustible presence of possibilities within a field dedicated to the enhancement of both natural and human environs. Ann Riley's work, and the example set by so many others, beg to be followed here at K-State; to embrace the idea of "equilibrium" as a means of conceptualizing the potential for a design on campus that is cohesive with the functions of the creek and with the functions of the university.

By visualization of the equilibrium concept as a landscape architecture masters project and report, this proposal also frames the possibilities for the evolving academic institution and community of Kansas State University. The improvement of social and aesthetic function on campus is inherent with appropriated improvement of hydrologic function of Campus Creek. The creek is Kansas State University's back yard. An opportunity exists on campus for the creek to become a naturally organizing element for both future development, and for retrofitting the campus where the creek has been forgotten.

It is time for Kansas State University to claim this prestige; a university committed to the improvement of, and impact on, its local environment, intent on establishing a higher education and understanding of the processes of the natural world, and an institutional advocate for ecological stewardship. The campus creek corridor is the place to begin; to explore the potential for the campus landscape to coexist with the land on which it finds its footing and foundation. The opportunity is now for the campus and the creek to exemplify "equilibrium", to plan for the enhancement of the creek corridor and to explore the campus landscape design accordingly.

Chapters outlined in this document represent the process of completing a conceptual planning and design proposal: introduction to the projects dilemma and thesis, site inventory and assessment, program definition, and design visualization.

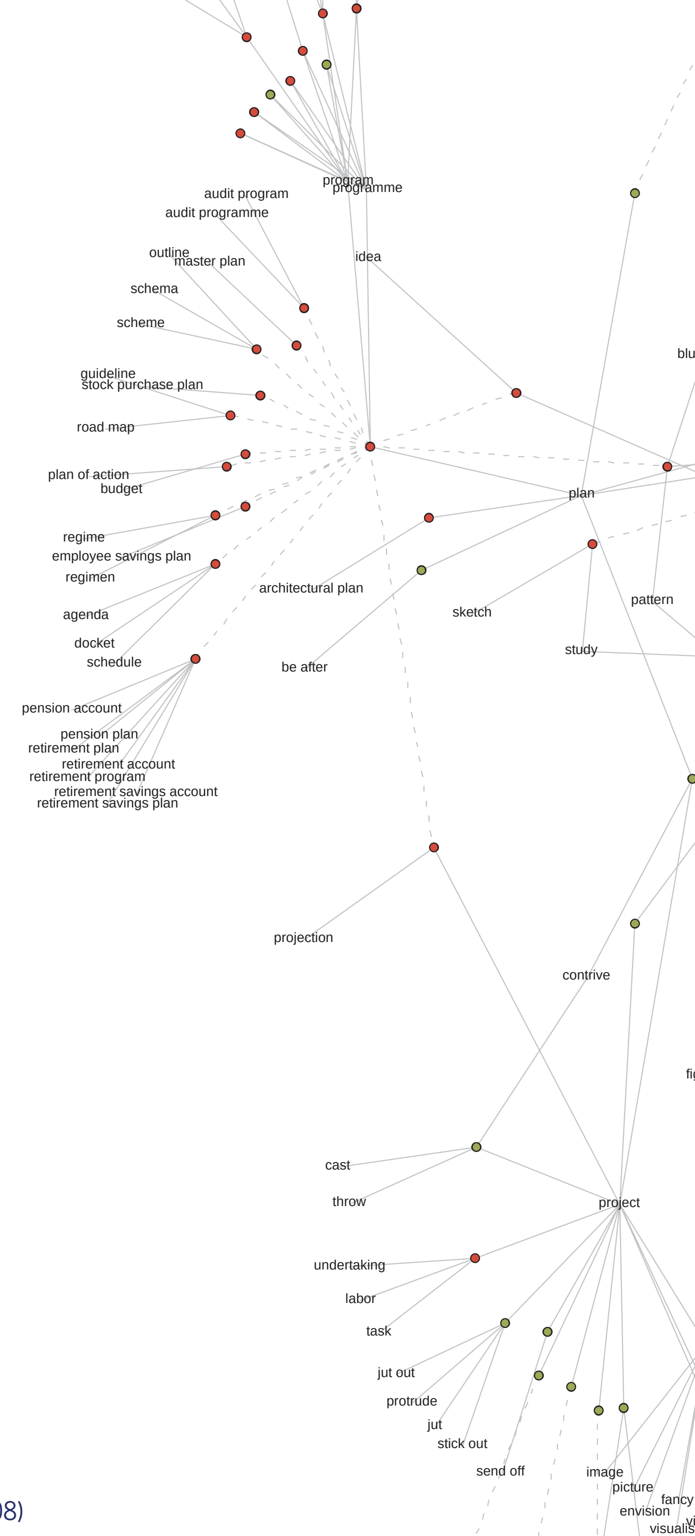
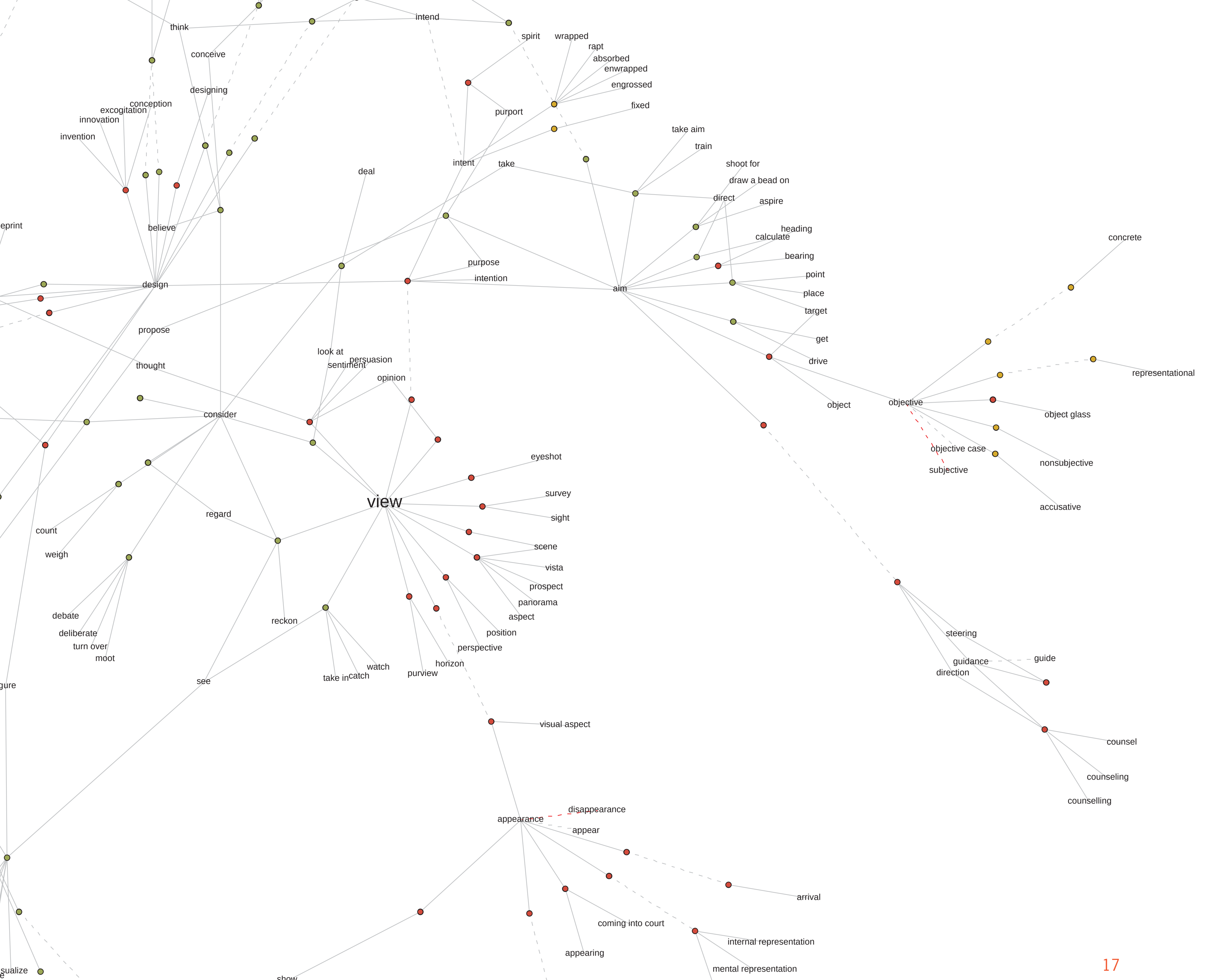


Figure 12 - View Brainstorm (Visual Thesaurus 2008)



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Inventory & Assessment

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Method

Inventory and assessment of Campus Creek is primarily concerned with hydrologic function within an urbanized sub-watershed. Methods of assessment are a means of informing better decisions during design and regarding enhancement of the creek. While both social and aesthetic considerations are included in the following process, this methodology prioritizes information gathering related to physical form and function of the channel, floodplain, and sub-watershed.

Assessment begins with delineation of the Campus Creek sub-watershed. This sub-watershed is then divided into individual catchment areas as they contribute to separate reaches of the creek also determined in this process. Surface types are then determined, areas delineated and quantified per catchment, and storm-water run-off quantities are calculated using an adaptation of the Rational Method (Dunne and Leopold 1978). Storm-water discharge quantities throughout the creek system are essential to informing channel manipulation, planning, design, and sizing various components of storm-water best management practices as a part of this proposal.

Aside from storm-water quantities, qualitative assessment of the entire sub-watershed is also necessary. Characterizations of each catchment are included as the result of additional catchment mapping, site visits, and site photography during both sunny days and storm events.

Following assessment, conclusions are drawn as a summary of the whole sub-watershed. Assumptions about missing information are then made, and overall opportunities and constraints are determined for enhancement of Campus Creek.

Data Compilation

Inventory and assessment was completed with the assistance of computer aided drafting in AutoCAD Civil 3D 2009, as well as mapping of geographic information systems with ArcGIS Desktop 9.3 (Figure 13).

Data compiled, utilized and/or produced for assessment of the Campus Creek and sub-watershed include the following:

- LIDAR 2 Meter Digital Elevation Model (DASC 2006)
- Slope Percentage Mapping
- Slope Aspect Mapping
- Soil Types (NRCS)
- HUC 14 Watershed Data (NRCS)
- Sub-watershed Delineation
- Catchment Delineation
- Campus Utilities Database (KSU 2007)
- Campus Road and Infrastructure (KSU 2007)
- Surface Type Runoff Coefficients (Strom, Nathan, and Woland 2004)
- Surface Type Area Delineation
- Campus Tree Inventory (KSU 2008)
- Local Precipitation Data (NWS 2009)
- Regional Rainfall Intensity Curves (Strom, Nathan, and Woland 2004)
- Stream Type Classification (Rosgen 2007)
- Total and Peak Discharge Quantities
- Bank-full Channel Dimensions
- Floodplain Dimensions
- Existing Channel Pattern and Profile
- Aerial Photography (DASC 2006)
- KSU Master Plan Documents (KSU 2007)
- Historical Campus Maps (Tolliver 1996)
- Site Photography
- Historical Illustrations (Fischer 1992)

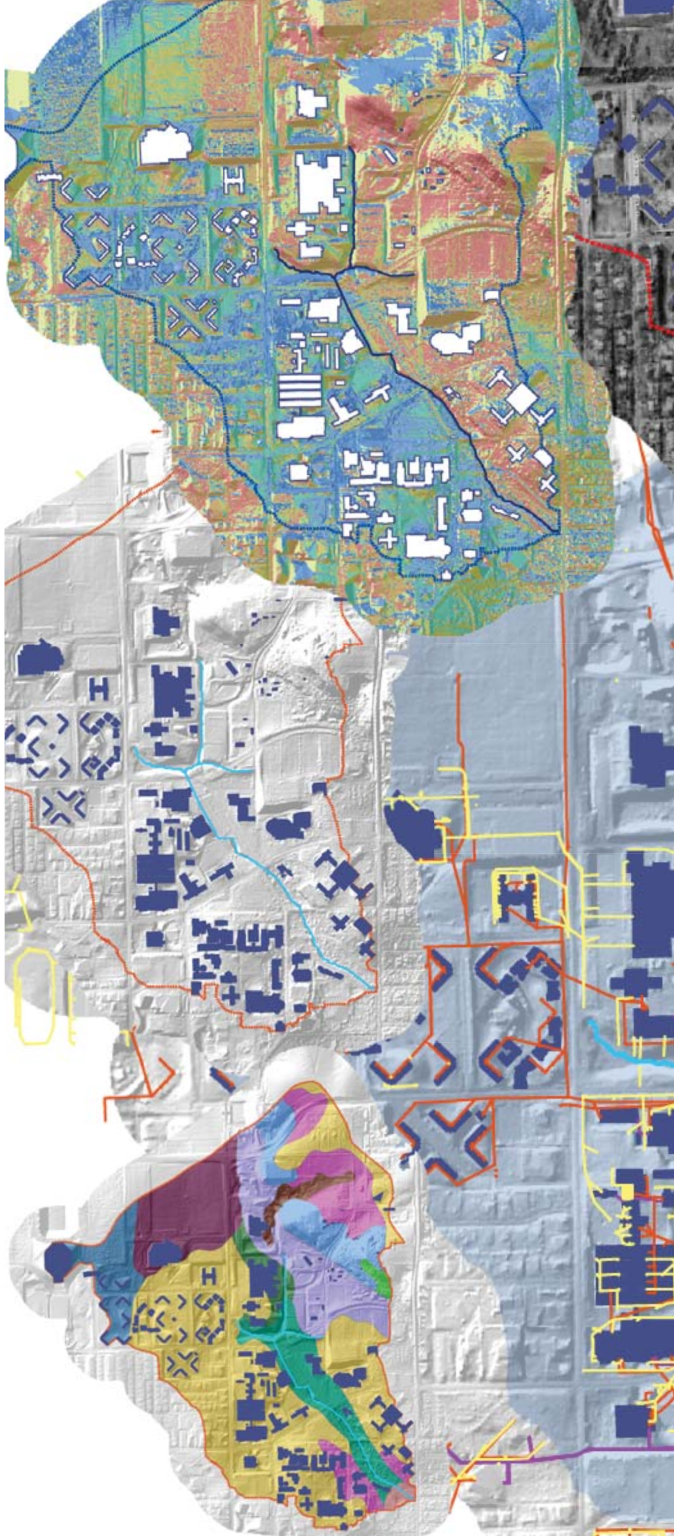
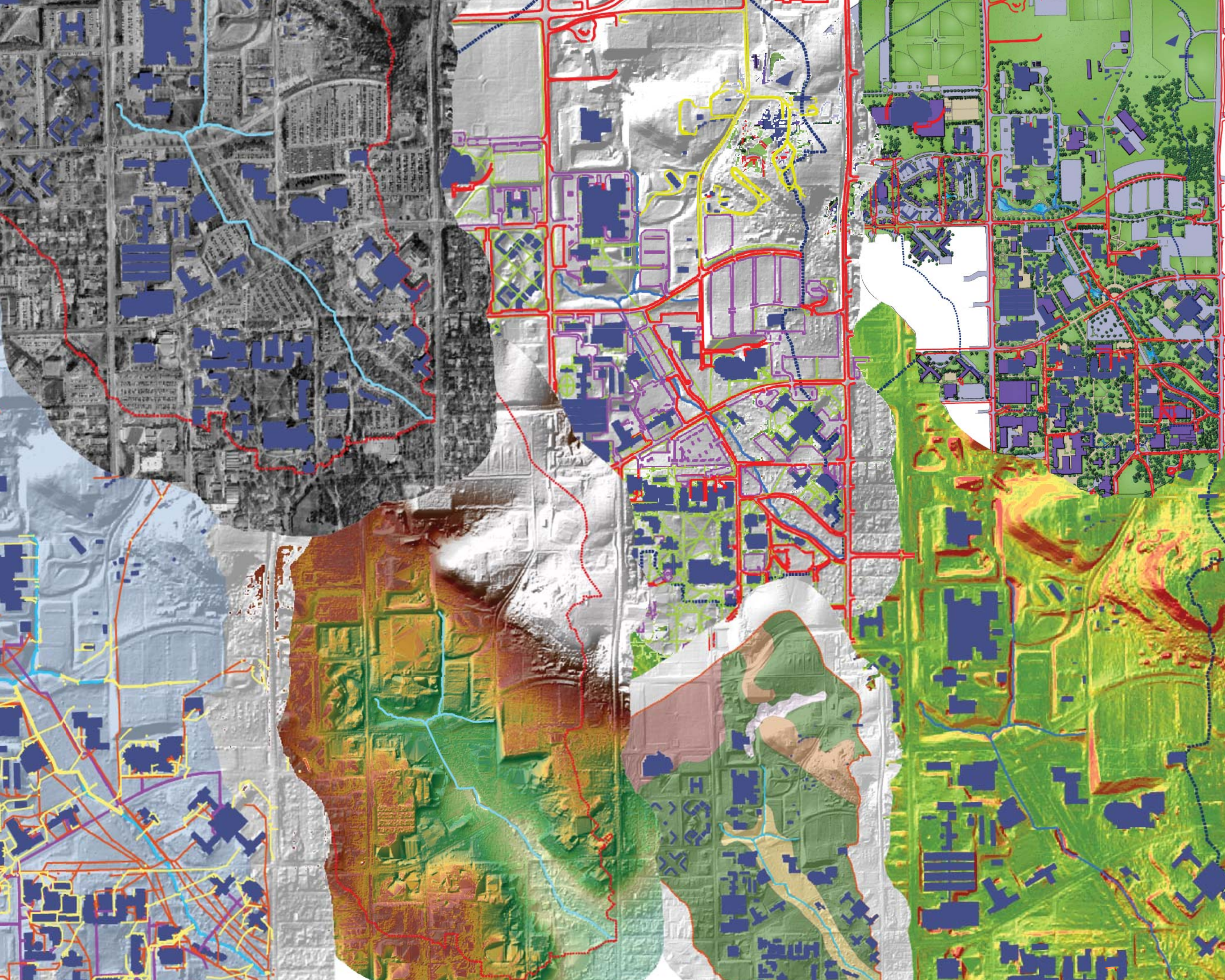


Figure 13 - Inventory Map Collage (Meihaus 2008)



Assessment

Sub-watershed Delineation

Watershed delineation for Campus Creek began by obtaining HUC 14 watershed data for the state of Kansas (NRCS). HUC level 14 watershed boundaries were then placed on top of a digital elevation model, DEM, generated from the Riley County Two-Meter LIDAR NED (DASC 2006). One foot increment contours were created from the LIDAR data, and in combination with aerial photography and campus maps, the flow line for Campus Creek was accurately determined (Figure 14).

Using the flow line of the creek and the HUC 14 watershed boundary as a base, the sub-watershed boundary was drafted on top of the one foot contour data. Building rooftops, roads, and storm-water infrastructure were also used in the mapping of the sub-watershed from the HUC 14 boundary on the northern edge to the outfall point on the southern end of the flow line.

Catchment Delineation

Within the campus creek sub-watershed, individual catchment area were determined in a similar method as described before (Figure 14). Individual catchments represent a contributing area of run-off based on a more refined outlet point along the channel. Several outlet points along the creek flow line were determined at various bridges and culvert pipes as a means of separating the sub-watershed for later quantification of storm-water run-off. These points along the creek represent critical sections of the sub-watershed and channel reaches to be assessed separately, Quantitative and qualitative assessment of these individual catchments are used in various combinations later in conclusion and to inform planning and design decisions.

Run-off Calculations

One of the purposes for delineating the Campus Creek sub-watershed and more precisely, catchments, is to have more manageable areas for complete the Rational Method to estimate storm-water run-off quantities. The Rational Method uses run-off coefficients applied to areas of separate surface types commonly found in urban and agricultural watersheds of up to one square mile (Dunne and Leopold 1978, p.298). This, in combination with regional rainfall intensity data, yields peak stream-flow discharge at the outlet of the sub-watershed or catchment for a particular storm event (Marsh 1991). This borrowed method is appropriately applied to the urban and agricultural context and scale of Campus Creek.

Before calculating storm-water run-off, surface types for each catchment area must be determined by coefficient and delineated accordingly. Surface cover types found and sub-divided in the Campus Creek sub-watershed per catchment include: gravel, impervious, pasture, wood, turf grass, and single family (Figure 15). These areas, as well as all areas mapped in the assessment process, were accurately drafted and measured in AutoCAD Civil 3D 2009 using a combination of campus infrastructure data, aerial photography, and land surveys of the campus. All assessment maps were produced in combination with AutoCAD and ArcMAP 9.3.

After the delineation and measurement of the appropriate surface types and areas, an adaptation of the Rational Method was used to quantify and summarize storm-water run-off calculations for each catchment area of Campus Creek (Table 01).

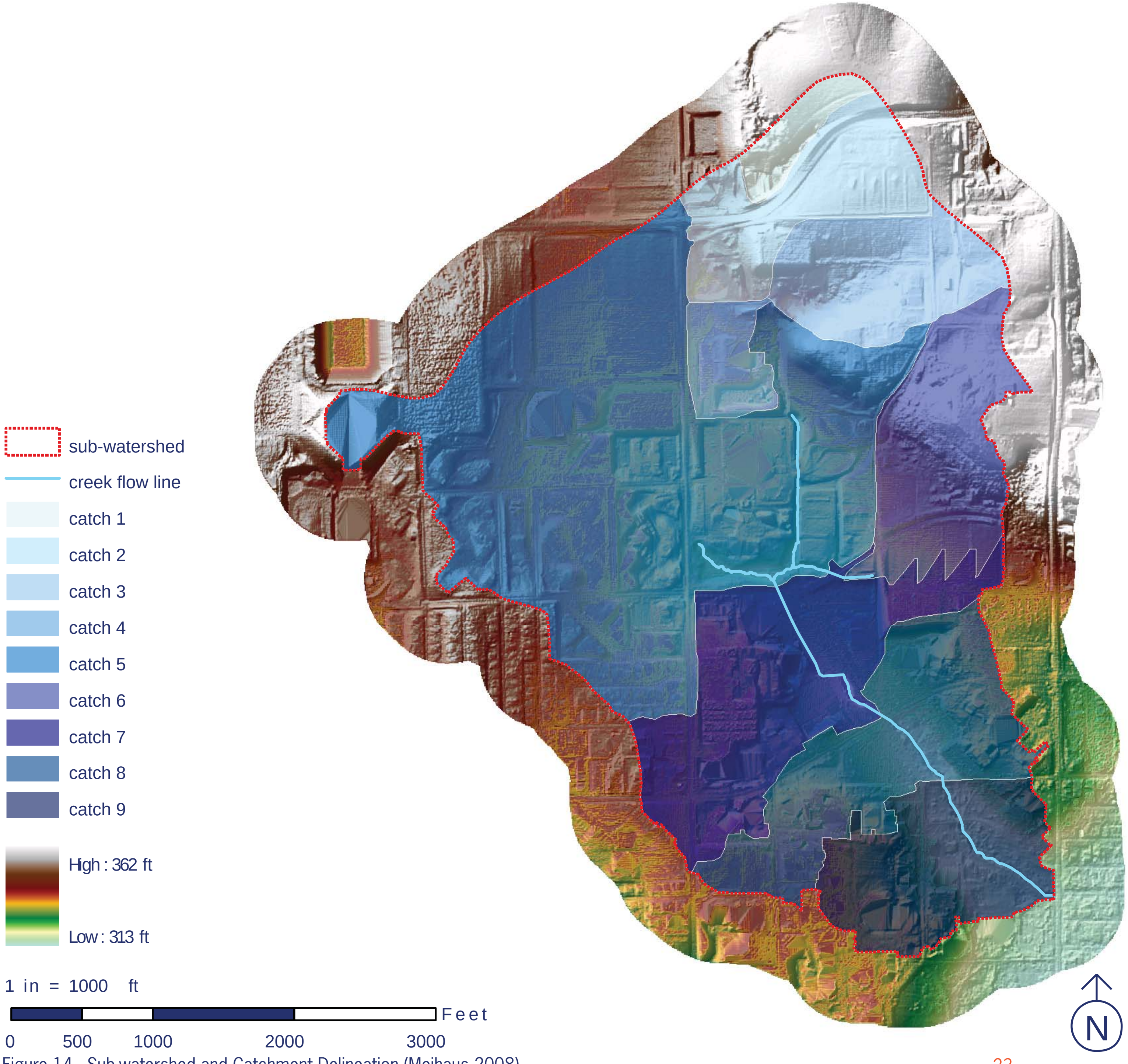


Figure 14 - Sub-watershed and Catchment Delineation (Meihaus 2008)

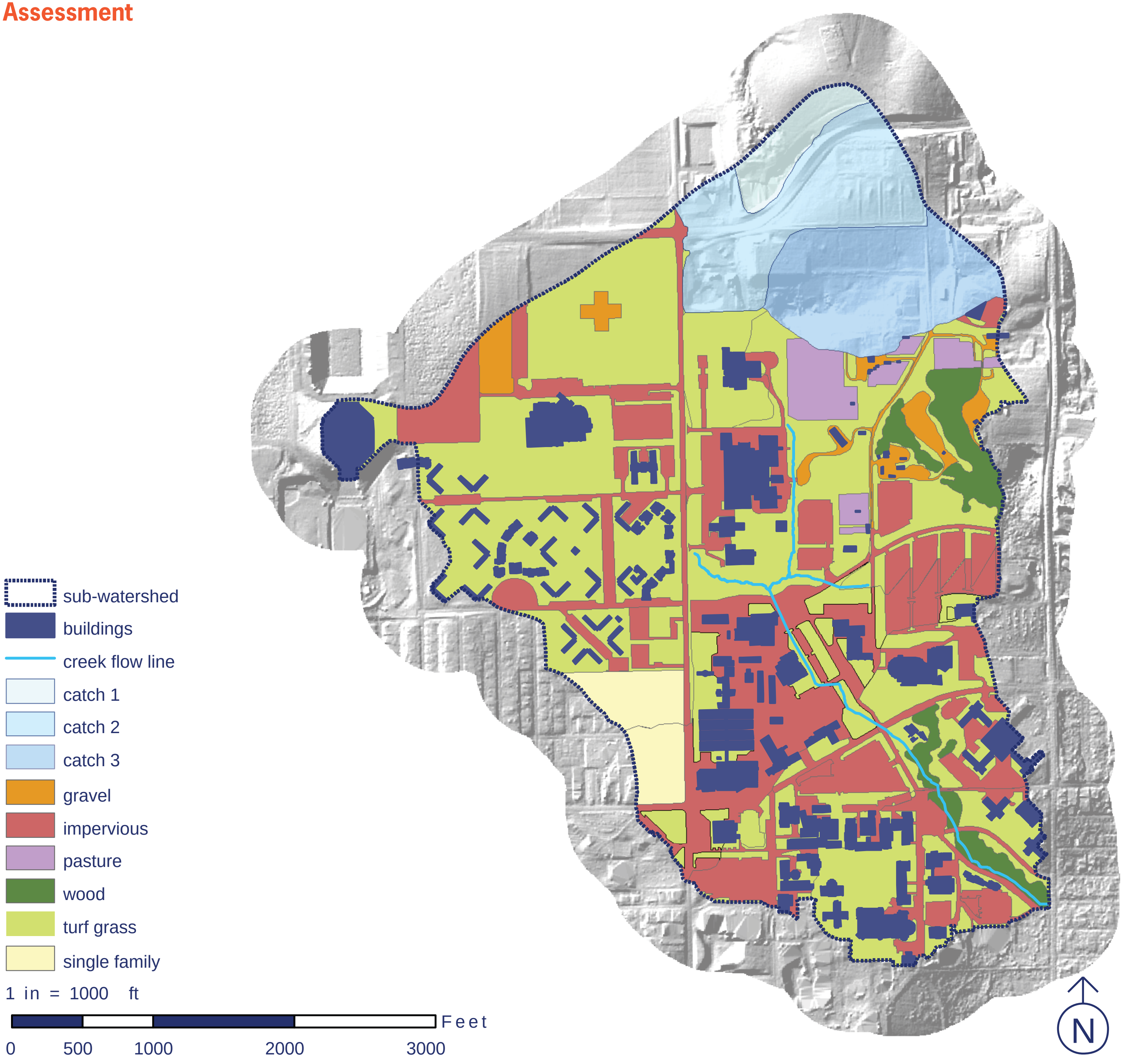


Figure 15 - Surface Type Delineation (Meihaus 2008)

SUMMARY OF SUB-WATERSHED DELINEATION OF SURFACES AND DISCHARGE CALCULATIONS BY CATCHMENT AREA USING THE RATIONAL METHOD										
SURFACE	Area (sq. ft.)	% Area of catchment	Run-off Coefficient	Adj. Avg. Coefficient	(Ac) sq. ft. = Area X Adj. Avg. Coefficient	Ac (converted to acres)	(Q) Total Discharge (converted to acre ft./ hr.) = Ac X 1.6 in./hr.	(Tc) Time of Concentration = .619(1.1 - C)(L^.5)(S^-.33)	(Q2) Two Year Storm (cfs) with R.I. adj. to Time of Concentration	(Q100) 100 Year Storm (cfs) with R.I. adj. to Time of Concentration
Catchment #1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Catchment #2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Catchment #3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Catchment #4										
Impervious	79433.57	0.18	0.9	0.165						
Turf	352955.67	0.82	0.25	0.205						
TOTAL	**432389.24**	**1**		**0.37**	**159984.02**	**3.67**	**0.5**	**20.87**	**11.73**	**18.88**
Catchment #5										
Impervious	2261388.110	0.32	0.9	0.288						
Gravel	244390.22	0.03	0.6	0.018						
Single Family Res. Urban	260562.19	0.04	0.5	0.02						
Pasture	341695.46	0.05	0.3	0.015						
Turf	4066460.58	0.56	0.25	0.14						
TOTAL	**7174496.560**	**1**		**0.481**	**3450932.85**	**79.22**	**10.56**	**31**	**206.76**	**353.32**
Catchment #6										
Impervious	356022.88	0.23	0.9	0.207						
Gravel	191431.87	0.13	0.6	0.078						
Woodland	370741.25	0.25	0.3	0.075						
Pasture	68988.86	0.05	0.3	0.015						
Turf	516352	0.34	0.25	0.098						
TOTAL	**1503536.86**	**1**		**0.473**	**711172.93**	**16.33**	**2.17**	**13.7**	**64.83**	**99.83**
Catchment #7										
Impervious	1675373.35	0.68	0.9	0.612						
Single Family Res. Urban	201405.78	0.08	0.5	0.04						
Turf	594301.85	0.24	0.25	0.06						
TOTAL	**2471080.98**	**1**		**0.712**	**1759409.66**	**40.39**	**5.39**	**13.76**	**160.34**	**246.9**
Catchment #8										
Impervious	1,168,335.97	0.59	0.9	0.531						
Woodland	80436.81	0.04	0.3	0.012						
Turf	733284.91	0.37	0.25	0.093						
TOTAL	**1982057.690**	**1**		**0.636**	**1260588.69**	**28.94**	**3.39**	**13.5**	**115.73**	**178.18**
Catchment #9										
Impervious	660463.33	0.44	0.9	0.396						
Woodland	148560.8	0.09	0.3	0.027						
Turf	706287.66	0.47	0.25	0.118						
TOTAL	**1515311.79**	**1**		**0.541**	**819783.68**	**18.82**	**2.51**	**17.14**	**67.99**	**106.11**

Table 01 - Storm-water Run-off Calculations (Meihaus 2008)

Assessment

Catchment Characterization

Characterizations of each catchment area within the Campus Creek Sub-watershed are based on the following: multiple site visits, site photography, aerial photography, and sub-watershed assessment mapping for utilities, campus infrastructure, surface types, slope percentage, slope aspect, soils types, surface types, and KSU Campus Master Plans. Descriptions of each catchment qualitatively address hydrologic, social, and aesthetic existing site conditions respectively, alongside appropriated site photography.
Campus Creek was visited and photographed on September 9th, 12th, and 21st in 2008, and on March 3rd, 2009 (Figure 16). The NCDC Station in Topeka Kansas recorded 2.32 inches of precipitation on September 9th, 2008, and 1.19 inches on March 3rd, 2009 (NWS 2009).

Catchment 9

Hydrologic function of campus creek within catchment nine, as it sits at the bottom of the entire sub-watershed, suffers from advanced urbanization and a multitude of direct impact development conditions. Campus Creek Road runs within 10 to 30 feet of the south banks of the channel for about half of the catchment reach. Petticoat Lane crosses the channel, constricting the channel under a small bridge and eliminating any active floodplain. A parking lot on the upper end of the catchment sits almost directly along western banks of the channel, which suffers from severe erosion endangering the integrity of the pavement and adjacent turf areas. Campus Master Plans call for replacement of this parking lot with a new Leadership Studies Building which plans for concrete retaining walls to control bank erosion against the footings of the new structure (Figure 16). The new building is the latest intrusion on the integrity of Campus Creek.

The channel suffers from many common urbanized conditions: stream-bank erosion, widened and straightened channel pattern, bank incision, and channel degradation. These symptoms are the typical result of excess run-off from the entire sub-watershed. Arguably the only feature holding the channels banks in tact is the relatively high amount of mature and established woody vegetation, although mostly invasive. Many storm pipes outlet directly into the channel from paved areas and roofs. Additionally, one sanitary line and one steam pipe cross the channel. Approximately 44% of the catchment's surface is impervious, with the majority of the remaining surface managed for turf grass (Figure 16).

Current circulation within the creek corridor exists in the form of a fragmented and isolated Goldstein Nature Trail. A single footbridge across the channel connects the dormitory greens and complex with campus academic core, achieving moderate to high activity and regular use (Figure 16). All other pedestrian circulation across corridor relies on sidewalks along Petticoat Lane, serving the highest volume of corridor cross traffic on campus. Vehicular circulation is limited mostly to one way streets, with westbound traffic entering campus and crossing creek via Petticoat Lane. Campus Creek Road, running directly adjacent to and south of the channel, serves one way eastbound vehicular and pedestrian traffic out to Manhattan Avenue (Figure 16). Designated bicycle routes or trials are non-existent and circulation relies on walkways and one way streets lined with single sided parallel parking.

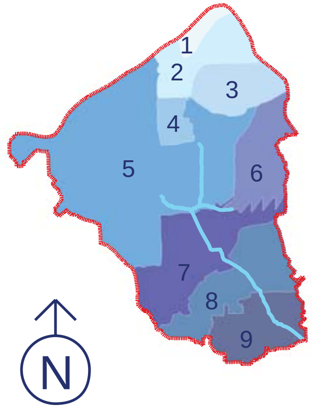
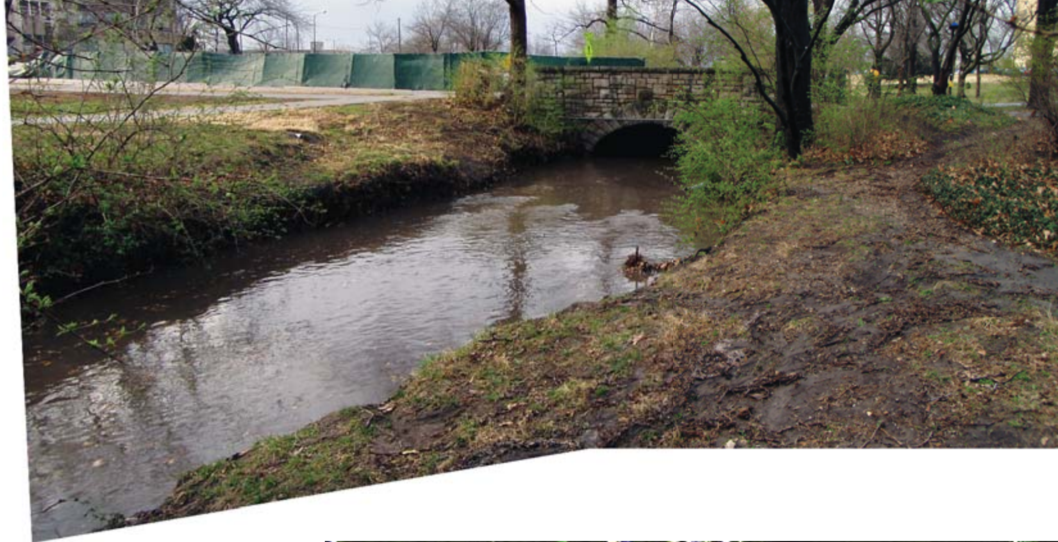
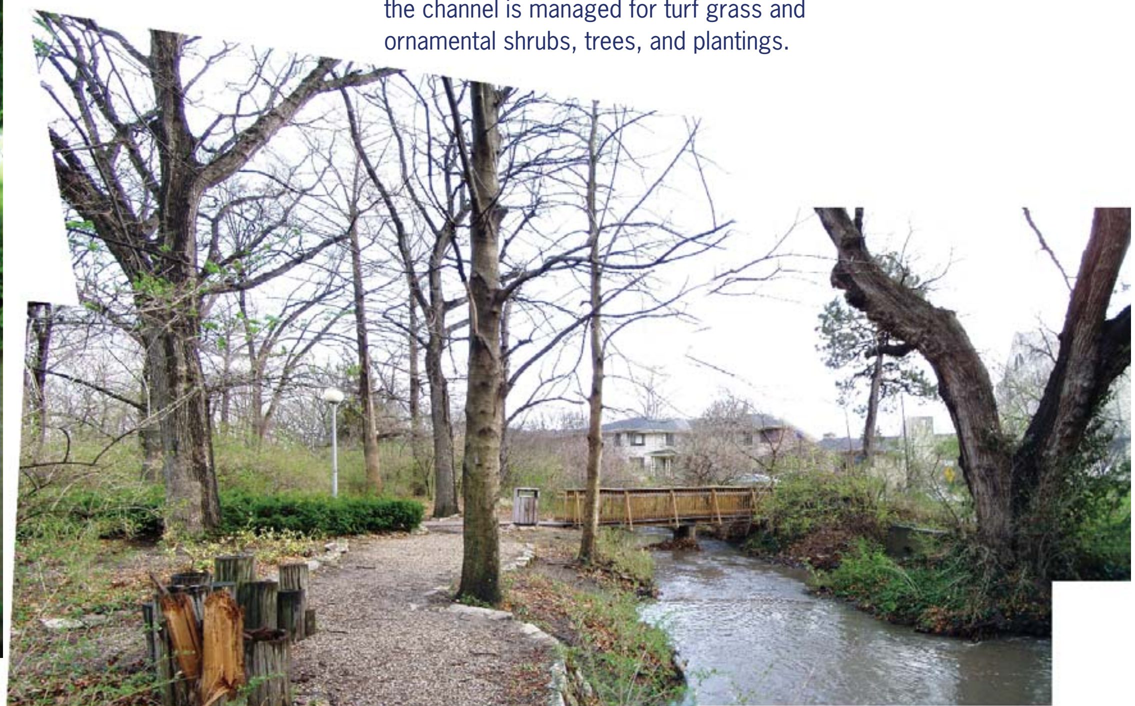


Figure 16 - Site Photography 9 (Meihaus 2008)



Some social function remains intact in the form of under-utilized gathering spaces within Quinlan Natural Area and along Goldstein Nature Trail. Lack of amenities, form, and space have limited the utility of these gathering and seating spaces. However, the site's potential for access to the creek is second to no other place within the corridor. Unlike most of the length of the channel, activity remains passive and no spaces are programmed for active interaction with the channel itself in terms of education or research. No current plans exist for improvement of Quinlan Natural Area (Figure 16).

The aesthetic function of catchment nine remains the most natural in overall appearance of all the areas of the corridor. The presence of mature woody vegetation dominates the scene for most of the channel. A unique character and sense of place are due to the soft texture of thick foliage and the tall canopy of the matured trees (Figure 16). Most of the catchment beyond the edges of the channel is managed for turf grass and ornamental shrubs, trees, and plantings.



Catchment Characterization

Catchment 8

Hydrologic function within catchment eight suffers from over 60% impervious surface cover (Figure 17). The creek shows both typical and severe urbanized conditions of bank-erosion along entire reach, and a wide, deep, straight channel. Turf grass areas border the banks of the channel on both sides with the exception of a short stretch of woody vegetation which lines the banks at the south end. Severe bank erosion persists even where woody vegetation is established, and many mature trees are undercut and in immediate danger of future bank incision and failure (Figure 17).

Expansive parking areas are the largest contributors to increased run-off within the watershed. Most storm water systems convey flows to channel via outlets at Claflin Road. A recent installment of a rain-garden for the roof of the International Student Center has decreased this buildings contribution to run-off. Other major roofs, however, such as the Derby Dining Complex and Haymaker Hall outlet on the surface within open green space behind the International Student Center. Steep slopes divide the dormitories and a relatively large, flat, and under-utilized green space behind the International Student Center and east of the Campus Creek (Figure 17).

Existing circulation around the channel is combined vehicular and pedestrian with the exception of the International Student Centers pedestrian bridge and a few minor walkways. Mid-Campus Drive and Claflin Road are dominated by high volumes of two-lane vehicular traffic through campus and accessing several parking lots. Campus Master Plans limit vehicular circulation to east half of Claflin Road ,crossing the creek, and south half Mid-Campus Drive, parallel to creek (Figure 17).

Social activity within and with campus creek are non-existent; no functional spaces lie within the corridor with the exception of the International Student Center, who's orientation and location relate directly to the channel.

Aesthetic function within this area of the corridor is dominated by relatively large, open lawns between the creek and surrounding campus roads and walkways. Density of vegetation disperses as one moves further upstream and to the north, disconnecting the character of mature woody foliage and canopy seen farther downstream in catchment nine (Figure 17).

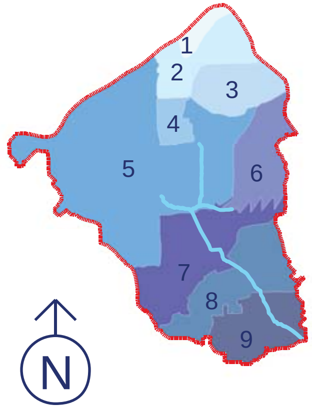


Figure 17 - Site Photography 8 (Meihaus 2008)

Catchment Characterization

Catchment 7

Hydrologic function within catchment seven suffers from the most severe urbanized conditions of the entire sub-watershed with approximately 70% impervious cover (Figure 18). The channel itself is consigned almost entirely to storm pipes with the exception of about 250 feet at the southern end. At this point the function of the channel is merely a conveyance system for storm-water. Dormitory parking lots, building roofs, and parking surfaces are largest contributors to excess run-off into channel. Campus Master Plans show the future piping of the only remaining stretch exposed to daylight in catchment seven (Figure 18). Significant drainage issues, not unlike catchments eight and nine, are apparent on open surfaces, lacking proper management of storm-water.

Historic path of the channel is currently dominated by Mid-Campus Drive and parking lots for Call, Dole, and Umberger Halls (Figure 18). Banks of the channel exceed 30% slopes where they are not controlled with concrete retaining wall structures for storm-drain outlets and along parking lots (Figure 18). Several storm pipes outlet into channel, and major steam and sanitary sewer lines run along west side of Call Hall (Figure 18). Most of the exposed channel shows signs of slumping of its banks, lacking vegetation or root structure other than weeds and turf grass (Figure 18). Campus Creek disappears beneath Claflin Road into two 36 inch culvert pipes for several hundred feet (Figure 18).

Existing circulation throughout catchment seven is dominated by access drives, parking lots, Mid-Campus Drive, and Jardine Road. Campus Master Plans limit vehicular through-traffic and remove Mid-Campus Drive north of Claflin Road for more pedestrian friendly campus environment. Call Hall seating area on west side of the building is the only socially functional or outdoor gathering space within the catchment. This area of the corridor functions only as means between the northern extents of campus and the academic core to the south.

Aesthetic function within the corridor is limited to formal landscape shrubs and trees along roads and walks and turf grass managed medians between parking lots buildings (Figure 18). Shrub and evergreen screens line parts of parking lots and corners of buildings with several dozen mature trees dispersed throughout corridor and catchment.

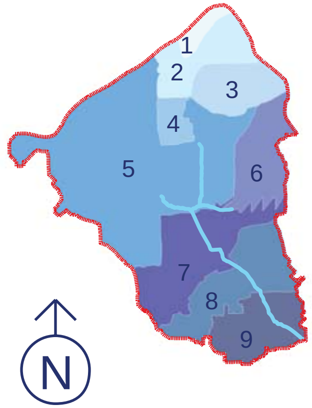


Figure 18 - Site Photography 7 (Meihaus 2008)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Catchment Characterization

Catchment 6

Hydrologic function within catchment six suffers mainly from generally steeper slopes as well as large parking areas covering about 20% of the surface (Figure 19). Steeper slopes in catchment six, although wooded or densely vegetated, increase the intensity of run-off significantly. Run-off from impervious areas is conveyed via storm pipes directly into a small concrete lined channel in the southwest corner of the catchment and running beneath Jardine Road in to catchment five. Campus Master Plans show this section of the channel piped beneath the eventual re-alignment of Jardine Road (Figure 19).

Approximately half of the dormitory parking lot surface area contributes run-off to this section of channel (Figure 19). Run-off from catchments four and six convene into one channel within catchment five south of the Vet. Med. Complex. Although these areas all contribute to the same channel, separate delineation of catchment six is necessary for obtaining isolated run-off quantities from dormitory parking lots.

Existing circulation within catchment is comprised mostly of northern end of dormitory parking lots, eastern end of Jardine Drive, and gravel roads extending to the north end of campus (Figure 19). An exercise trail runs north up the wooded hill on the east edge of the catchment.

Aesthetic function of catchment six is a mix of parking lots lined with a few shade trees and a large south-facing hill slope dominated by natural woodlands. The small section of the catchment along Jardine Drive intersecting the channel and corridor are managed for turf-grass and lack any distinguishable character. Following the trend from south to north, this area of campus has a much lower density of buildings than catchments seven, eight, and nine (Figure 19). A lack of structures also means a lack of utilities and of general campus infrastructure.

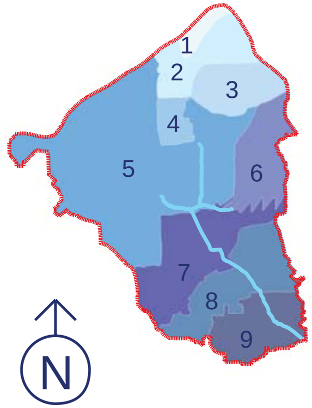

Figure 19 - Site Photography 6 (Meihaus 2008)

Catchment Characterization

Catchment 5

Hydrologic function within catchment five is complex and has the largest contributing area of all the catchments. The creek corridor and channel however, are proportionality small to the size of the catchment, contributing run-off from the Recreation Center and ball fields, football stadium parking, Jardine Apartments, Vet. Med. Complex, and pastures and holding pens (Figure 20).

Excess peak flows have resulted in a rapidly changing channel and altering flow patterns south of the Vet. Med. Complex where an apparent floodplain and channel connection remains intact (Figure 20). Here the narrow channel and apparent floodplain is managed for turf grass throughout. Channel degradation, bank erosion, gully formation, and braiding are visibly increasing with each moderate to major storm event. In addition to culvert and storm-water pipes from beneath Denison Avenue and from catchments four and six, several down spouts outlet into this section of the channel from Vet. Med. complex (Figure 20).

The channel between Vet. Med. and parking lot functions merely as storm water conveyance, suffering from excess run-off and requiring conventional bank-stabilization methods to retain parking lots and roads. Run-off from steep hills north of channel also contribute to degradation of hydrologic function downstream. Several swales surrounding parking areas and pastures are managed for turf grass and lack vegetative presence, diversity, or any means of significantly reducing urban storm-water run-off (Figure 20).

Existing circulation around the corridor consists of Jardine Road along the southern edge, Denison Avenue on the western edge, Vet. Med. parking lot on the eastern edge, and one pedestrian bridge crossing the channel and connecting Mid-Campus Drive with the Vet. Med. Complex (Figure 20). Social activity is limited almost entirely to a means of circulation to Vet. Med. Center, Jardine Apartments, and Recreation Center. Small plazas and seating areas are located between Vet. Med. buildings, all inwardly focused and disconnected by open lawns. Campus Master Plans illustrate the extension of the KSU Gardens across Jardine Road and into the creek corridor (Figure 20). Impact of future plans for the Gardens are discussed in more detail in the Design Chapter of this document.

Aesthetic function is that of a high maintenance landscape including large turf grass open spaces and scattered specimen woody trees and shrubs. Patches of overgrown woody weeds and woody vegetation can be found on the banks of the channel, as well as one large patch of cattails, cord grass, and reeds along western channel (Figure 20). Views across channel are open and only interrupted by distant buildings and isolated trees. Campus Creek has merely a sliver of a presence compared to the size of catchment five.

Walkways, roads, and parking lots are paved with concrete, lit at night with standard university street lighting. Unlike the rest of catchment five, Jardine Apartments to the west exhibits a multitude of site furniture and character. The re-development of this site however, makes no recognition of the channel opposite Denison Avenue, or consideration of excessive run-off endangering more aesthetically pleasing stretches of the creek further south into campus.

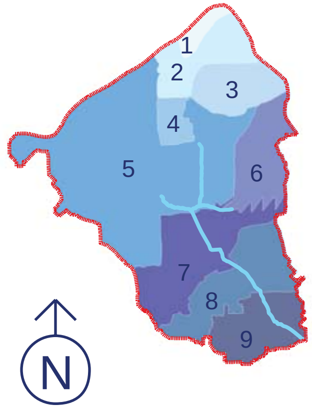

Figure 20 - Site Photography 5 (Meihaus 2008)





Catchment Characterization

Catchment 4

Hydrologic function consists of a parking lot swale, culvert under parking drive, and a large retention basin at the bottom of this small catchment area. Delineation of this area separate from catchment five is a means obtaining isolated run-off quantities from the recently constructed Pat Roberts Hall and the retention area to the south (Figure 21). Future piping of run-off from catchments one, two, and three is expected with further development of the campus. Currently, much of the run-off from this area is diverted to storm pipes along Denison Avenue, bypassing the outlet point at the southeast corner of the catchment area.

Existing circulation consists of a parking lot for Pat Roberts Hall (Figure 21). Curb cuts along the west edge of the lot drain surface run-off into a turf grass swale and into a culvert pipe beneath the parking lot entry drive. Pedestrian circulation runs north and south along Denison Avenue and from Pat Roberts Hall to the parking lot.

Aesthetic character is non-existent. Most of the catchment is off-limits to the public but remains visible. Only turf-grass and a black iron fence stand between Pat Roberts Hall, the parking lot, and Denison Ave. Steeper hills to the east of the catchment are mostly overgrown and un-managed.

While catchment four does contribute to Campus Creek, it has a relatively minor impact on the channels in catchment five. Urban influence on Campus Creek could easily be isolated from hydrologic function in catchment five.

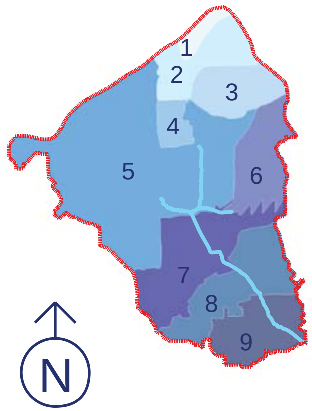

Figure 21 - Site Photography 4 (Meihaus 2008)

Conclusions

Assumptions

Limitations of time, project scope, scale, available information, and tools for proper and practical assessment of Campus Creek result in the need for some assumptions. These assumptions concern peripheral site issues, missing or unclear site information, the approximation of calculations, and non-contributing factors.

During delineation of the Campus Creek sub-watershed, it was unclear whether boundaries interpolated from the HUC 14 data set were accurate. Subsequent assessment of these areas during catchment delineation accompanied by storm-water utility data raised the question whether catchments one, two, and three even contribute to Campus Creek. Due to human alterations to the sub-watershed, these areas may have been isolated from the creek in terms of storm-water run-off. While they are still technically within the boundaries of the sub-watershed, they have been labeled as non-contributing catchments until otherwise discovered or altered later by further manipulation of storm-water run-off. As a result, run-off quantities from catchments one, two, and three have not been accounted for in any calculations.

All quantifiable assessments of Campus Creek are approximations to serve as preliminary guidelines for planning and design decisions within the proposal. Storm-water run-off quantities are all estimates based on one method of a many, varying in level of detail, accuracy, and application.

It is assumed the current KSU Master Plan is an fairly accurate representation of the future development of the campus (Figure 23). A combination of the KSU Master Plan and the existing form of the campus are taken into consideration during assessment, programming, and design. This proposal, as an exploration of long-term possibilities for the Creek Corridor, utilizes a hybrid of current and future campus plans, manipulating both into a new concept alternative focused around the creek.

Figure 23 depicts continued piping of the creek throughout the campus. Several retention ponds on visible in line with the creek. These ponds are assumed plans for significant alterations to the creek which will further degrade any chance for enhanced natural hydrologic function.

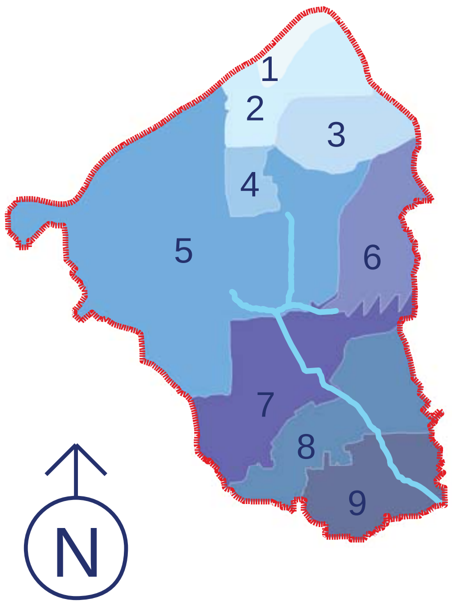

Figure 22 - Catchment Reference Map (Meihaus 2009)

Figure 23 - Current KSU Master Plans (Meihaus 2009)

Program

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Process

Re-statement of Goals & Objectives

Enhance Hydrologic Function

1. Remove and substitute for past, present, and future development directly impacting hydrologic function of the watershed, channel, and floodplain.

2. Manipulate and re-create three dimensional stream channels for physically stable form and naturalized hydrologic function.

3. Retro-fit urban storm water best management practices for current and future impervious areas contributing excess run-off affecting hydrologic function of the urban watershed and physical stability of the channel.

4. Establish and manage a channel buffer zone and proper floodplain corridor for both native riparian and wet-mesic prairie vegetation respectively.

Enhance Social Function

1. Improve pedestrian and bicycle circulation experience laterally and transversely by way of the Campus Creek corridor.

2. Increase social activity for general campus interaction and academic utility including opportunities for small gatherings within the campus creek corridor.

Enhance Aesthetic Function

1. Prescribe a balance of natural and formal character, visual connectivity, and a sense of place for identifying with the Campus Creek corridor.

2. Manage the corridor for minimal turf-grass open space, non-invasive woody species providing overhead canopy, and suitable wet-mesic prairie vistas.

3. Instill an environmental sensitivity toward Campus Creek through artistic expression of urban hydrology, form, and function.

Relationships & Organization

No formal or detailed program for improvements is ever established prior to or within this proposal. Programming elements to be included in planning and design are based on achieving project goals and objectives, and to progress the conceptual nature of this proposal. Visualizing Urban Equilibrium does not intend to deliver an exact program of improvements.

The process of exploring project goals, to objectives, potential program, and design of a final concept is viewed as a continuum. Project objectives are an elaboration of project goals, and aid in the listing of a potential program organized by catchment area. Inventory and assessment informs definition of potential program elements, which are prioritized based on the weight of goals and objectives to which they apply.

In this conceptual project even the process of planning and design aim to further define program elements. After initial definition of project intent, programming for improvement is a cyclical process (Figure 24). Featured program elements for this part of the cycle are described in the Design section of this document.

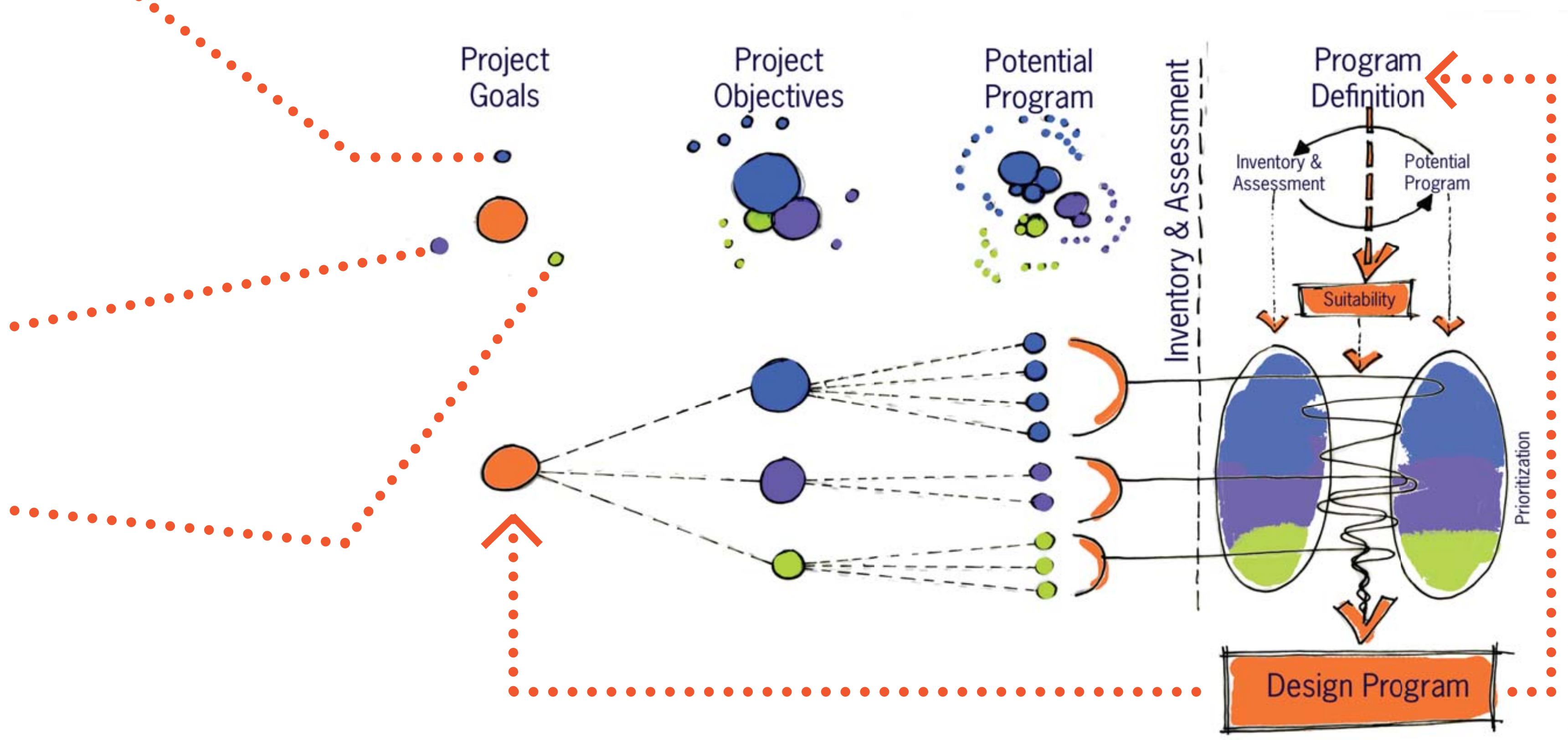

Figure 24 - Program Relationships (Meihaus 2008)

Potential Program

Program opportunities are organized by catchment and labeled with the appropriate goals and objectives addressed in parenthesis. Goals and objectives accomplished serve as the criteria for prioritization of potential program elements and definition of a final program for design (Figure 25). Featured program elements are discusses further with the description of the comprehensive plan and elaboration on design organized into reaches of Campus Creek in the following Design Chapter.

Catchment 9

a. Re-design of natural channel and discontinuous floodplain without compromising established woody species and character (H24 A12).

a. Re-establishment, design, and extension of Goldstein trail for pedestrian and bicycle use including trail head at Manhattan Avenue and Campus Creek Road, and improved connectivity through campus and creek corridor (S12).

b. Re-design of gathering spaces within Quinlan Natural Area for improved visibility, seating, diversity of function, and accessibility to Campus Creek (S12 A12).

c. Re-organization of future Leadership Studies Building site program to include amphitheater space and integrated storm-water BMP's (H123 S12 A123).

d. Removal of parking along north side of Petticoat Lane and retro-fit of BMP's (H13 A3)

e. Replacement of Mid-campus Drive with pedestrian corridor (H1 S1 A13).

f. Removal of Campus Creek Road (H1 S1 A13).

e. Establish buffer for conservation and management of mature, non-invasive woody species, visual character, and function of canopy along Campus Creek Road (H4 A12).

f. Increase native riparian vegetation and promote root structure establishment along destabilized banks of the channel along Campus Creek Road (H24 A12).

g. Retrofit bio-retention and level spreaders paralleling Campus Creek Road and plan pervious paving replacement of asphalt and concrete curb and gutter systems (H3).

h. Retrofit bio-retention and level spreaders paralleling Petticoat Lane and plans for pervious paving replacement of asphalt and concrete curb and gutter systems (H3).

i. Plan bio-retention for Campus Creek Complex, Justin Hall, Future Parking Garage and drives (H3).

Catchment 8

a. Removal of Mid-Campus Drive for pedestrian boulevard (H1 S12 A1).

b. Establish buffer for conservation and management of mature, non-invasive woody species, visual character, and function of canopy south of ISC (H4 A12).

c. Increase native riparian vegetation and promote root structure establishment along destabilized banks of the channel opposite and fronting ISC (H4 A12).

d. Retrofit bio-retention and level

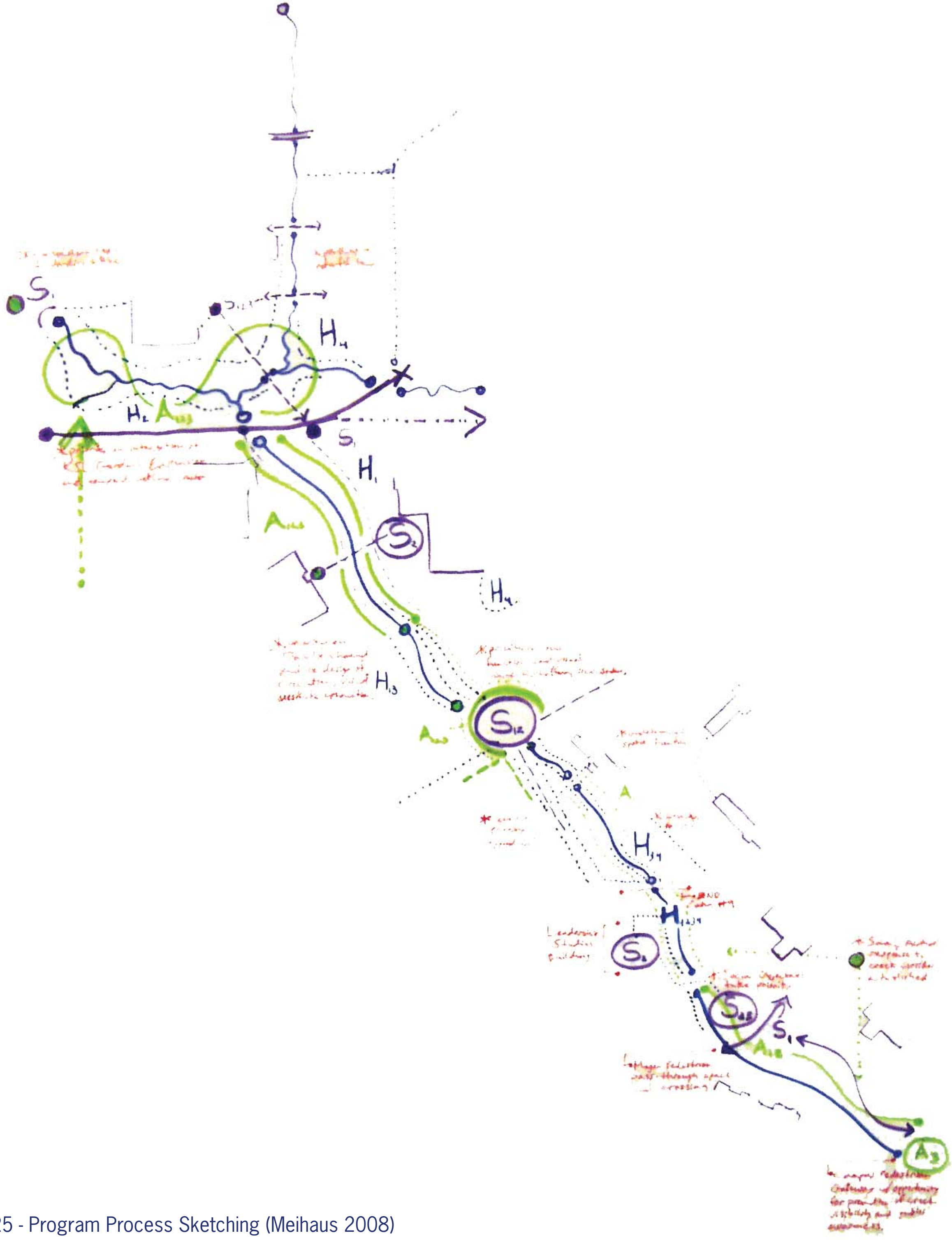

Figure 25 - Program Process Sketching (Meihaus 2008)

spreaders paralleling Claflin Road replacing concrete curb and gutter storm water conveyance systems (H3).

e. Extend Campus Creek multi-use trial on north side of channel for access to ISC, dormitory complex, and north across Claflin Road (S1).

Catchment 7

a. Daylight approximately 1200 feet of Campus Creek between Claflin Road and Jardine Drive: re-align channel with reconstructed profile, pattern, and cross-sectional dimensions with functional floodplains, terracing, meanders, pools, and riffles (H1234 S12 A123).

b. Remove culverts, concrete piping, roads, walks, parking, and re-configure cohesively with hydrologic function of day-lit channel (H1 S1).

c. Extend campus creek multi-use trial for access from Claflin Rd. to Jardine Dr. along north and south sides of day-lit channel (S1).

d. Establish buffer for conservation and management of mature, non-invasive woody species, visual character, and function of canopy for the day-lit channel (H4 A12).

e. Install native riparian vegetation and promote root structure establishment along destabilized banks of the day-lit channel (H4).

f. Retrofit bio-retention and swales according to current and dependent on re-configuration of paved areas within catchment and impacting day-lit channel (H4 S1 A13).

Catchment 6

a. Retrofit in-stream grade control structures and or detention of storm-water for short day-lit section west of dormitory parking lots at bottom of catchment (H1234 A123).

b. Establish buffer for conservation and management of mature, non-invasive woody species, visual character, and function of canopy along day-lit channel (H4 A13).

c. Increase native riparian vegetation and promote root structure establishment along destabilized banks of the small day-lit channel (H4 A13).

d. Retrofit bio-retention and swales according to current and dependent on re-configuration of paved areas within catchment and impacting day-lit channel (H4).

Catchment 5

a. Unified planning and design of open space south of Vet. Med. Center with future expansion of KSU Gardens across Jardine Drive: formal pedestrian and visual connectivity with the corridor, native planting displays, BMP demonstrations, seating areas, small gathering spaces, and permeable walkways (H1234 S12 A123).

b. Extend Campus Creek multi-use trial for access from Jardine Road to the Vet. Med. Center, Jardine Housing Complex, and north on Denison Avenue to Recreation Center (S1).

c. Re-design eastern Vet. Med. parking lot for increased channel buffer and redesign of pedestrian access bridges and walkways to Vet. Med. Center (H14 S1 A1).

d. Retrofit bio-retention and level

spreaders for eastern Vet. Med. parking lots (H4).

e. Retrofit rain gardens and level spreaders for Vet. Med. roof and general complex run-off (H4).

f. Establish buffer for conservation and management of mature, non-invasive woody species, visual character, and function of riparian floodplain for entire corridor (H4 A13).

g. Increase native riparian vegetation and promote root structure establishment along destabilized banks of the channel south and east of Vet. Med. Center (H4 A13)

Catchment 4

a. Retrofit bio-retention and level spreaders for existing swale along western edge of Pat Roberts Hall parking lot (H4).

b. Install native riparian vegetation and promote root structure establishment along destabilized banks of the day-lit channel (H4 A13).

Design

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Planning Comprehensively

This proposal focuses on the Campus Creek as a naturalized and organizing element for the corridor it occupies on campus. A Comprehensive Plan for the entire corridor is the result of an effort to optimize enhancement of the creek, and employ opportunities for campus planning and design based on a naturalized order within the corridor as it is defined in Figure 26. The plan shown represents a holistic approach to urban stream enhancement planning within the context of a large, urban, and agricultural, state university campus. This project and report represent a wholistic response to both sub-watershed assessment, and the needs of the campus socially and aesthetically. This chapter depicts a landscape architecture project which simply prioritizes a degree of hydrologic sensitivity in a campus environment, and which visually communicates the possibilities for Campus Creek corridor enhancement.

With the premise of prioritizing for the improvement of the creek, the design depicted in this chapter is hypothetical in nature. Re-creating a stable creek is based on naturalized geomorphic channel pattern, profile, and stable bank-full and floodplain cross-sectional areas. In theory, urbanized stream channels can be given calculated channel and floodplain dimensions within the range of naturally stable stream types to account for proper conveyance an estimated quantity of water, sediment, and flow rate. This basic method, defined in much greater depth and accuracy by in Geomorphic Channel Design (Rosgen 1997), serves as the basis for determining necessary plan pattern re-alignment, and channel design type selection for three separate reaches of Campus Creek. With an approximation of natural channel and floodplain design as a foundation, this proposal develops into an integration of a fully functioning, aesthetically pleasing, and purposeful campus design.

Wholistic Approach

Proper planning and design for improvement of channel, floodplain, and watershed function will inherently improve the campus socially and aesthetically. Promotion of a healthier creek as a usable space on campus in turn promotes a more dynamic educational and social environment for K-State students, faculty, and the community at large. Promotion of the creek's identity as a re-established natural element and a functioning, living, environment offers the campus a sense of place and a place worth caring about which would not otherwise exist. This proposal communicates the compatibility between planning for the future of the creek and planning for the future of the campus, and illustrates the "urban equilibrium" paradigm, as previously discussed.

Organization by Reach

In the natural order of any watershed, water quantities accumulate increasingly from the most remote point (in the case of Campus Creek, at the most northern point on the sub-watershed map Figure 27) to the lowest point (the outlet of the creek beneath N. Manhattan Avenue). Therefore, the order of operations for natural channel design begins with the upper-most reach within the sub-watershed. Each subsequent reach affects the next, and alterations to one channel without consideration of the one feeding it would prove unsuccessful in the long term life cycle of the creek.

In the circumstance of K-State's Campus Creek, the upper-most reach is located directly north of Jardine Drive, defined on its western edge by Denison Avenue, in the east by the Vet. Med. parking lot, and extending north to the grounds of Pat Roberts Hall. This reach of the creek and place on campus is entitled Campus Creek Gardens; a combined design effort from assessment of catchments four, five, and six. Directly downstream from the Campus Creek Garden reach is the Daylight reach. The Daylight reach lies entirely within catchment seven, and between Jardine Drive and Claflin Road, running parallel to the removed Mid-Campus Drive. Following south under Claflin Road and extending to the outlet beneath N. Manhattan Avenue defines the creek's South reach, encompassed by catchments eight and nine.

While the plan only depicts the creek within the boundaries of the corridor it runs through within these three reaches (Figure 26), the influence of urban and agricultural conditions extends to the entire sub-watershed. Due to the breadth of urban influence and size in area of the sub-watershed, this Comprehensive Plan focuses an effort to visually communicate enhancement of Campus Creek where it can be most easily identified and managed within the main university campus. A truly comprehensive effort would include extensive improvements to the entire sub-watershed and beyond an identifiable creek.

Figure 26 - Campus Creek Comprehensive Plan (Meihaus 2009)

Channel & Floodplain Design

In the practice of urban watershed improvement planning, the primary goal is to reduce peak run-off by infiltration first, and second, by volume storage as a means of protecting the stability of the respective channel and floodplain which convey the quantities of run-off accumulated by specific storm events. This principal is especially crucial in urbanized watersheds where storm events produce large amounts of run-off into channels with limited floodplains and disabled hydrologic function. The most crucial quantities of water are those which most frequently manipulate the form of the channel, known as the channel forming discharge or “bank-full discharge” (Dunne and Leopold 1978). With an estimate of bank-full discharge per designated channel, an appropriate natural channel design type can be selected from the Rosgen Stream Type Classification system based on approximate calculation of channel and floodplain dimensions (Figure 28).

Bank-full discharge is measured in cubic feet per second or cfs, and in the case of Campus Creek is equal to 65% of the peak discharge (Q) determined for each catchment area during Sub-watershed Assessment. During assessment of Campus Creek, peak discharge for each Catchment was based on a two year, 24 hour storm-event, or Q2. Since the Q2 is typically 1.5 to 2 times greater than bank-full discharge, only 65% is used. Bank-full discharge in cfs is then divided by an estimated bank-full velocity of 4 feet per second to obtain an area which represents the cross-section of the bank-full channel dimension required to convey bank-full discharge (Dunne and Leopold 1978).

With the cross-sectional areas determined for each critical length of the creek, and a basic understanding of the existing physical condition and urban context of each reach of the Campus Creek, a target stable channel type can be selected as a basis for channel and floodplain dimensions from the Rosgen Broad-level Stream Type Classification System (Rosgen 2007, 11-6). Each of Rosgen’s eight stream types is partially defined by a range of width to depth ratio of the bank-full channel dimensions. Using the cross-sectional area calculated for the channel lengths on Campus Creek, channel cross sections are drawn to emulate natural, realistic, representations of the appropriate width/depth ratio and Rosgen stream type (Figure 28).

The result of this process for determining design channel types ranged from type “E” in the upper reaches of Campus Creek Gardens, “C” in the middle Daylight reach, and “B” in the South reach (Figure 27). From here, other critical channel and floodplain dimensions were determined for each stream type including radius of curvature (meander curve radius of 3 times the bank-full width), sinuosity (stream length divided by valley length across at least two meanders), and slope percentage (estimated grade change divided by length).

The floodplain cross-sectional area for each channel type is also calculated. For floodplain cross-sectional areas in square feet, run-off quantities are equal to the peak discharge calculated for a 100 year storm event, or Q100, and divided by an average velocity of two feet per second. Unlike sizing channel dimensions for Bank-full discharge, floodplain dimensions account for the full Q100 peak discharge volume (Dunne and Leopold 1978). Table 02 outlines all calculations and critical dimension for each channel type and floodplain sizing. Dimensions calculated are checked against classifications appropriate for the target channel type, and adjusted accordingly for purposes of illustrating the design in plan, cross-section, and perspective.

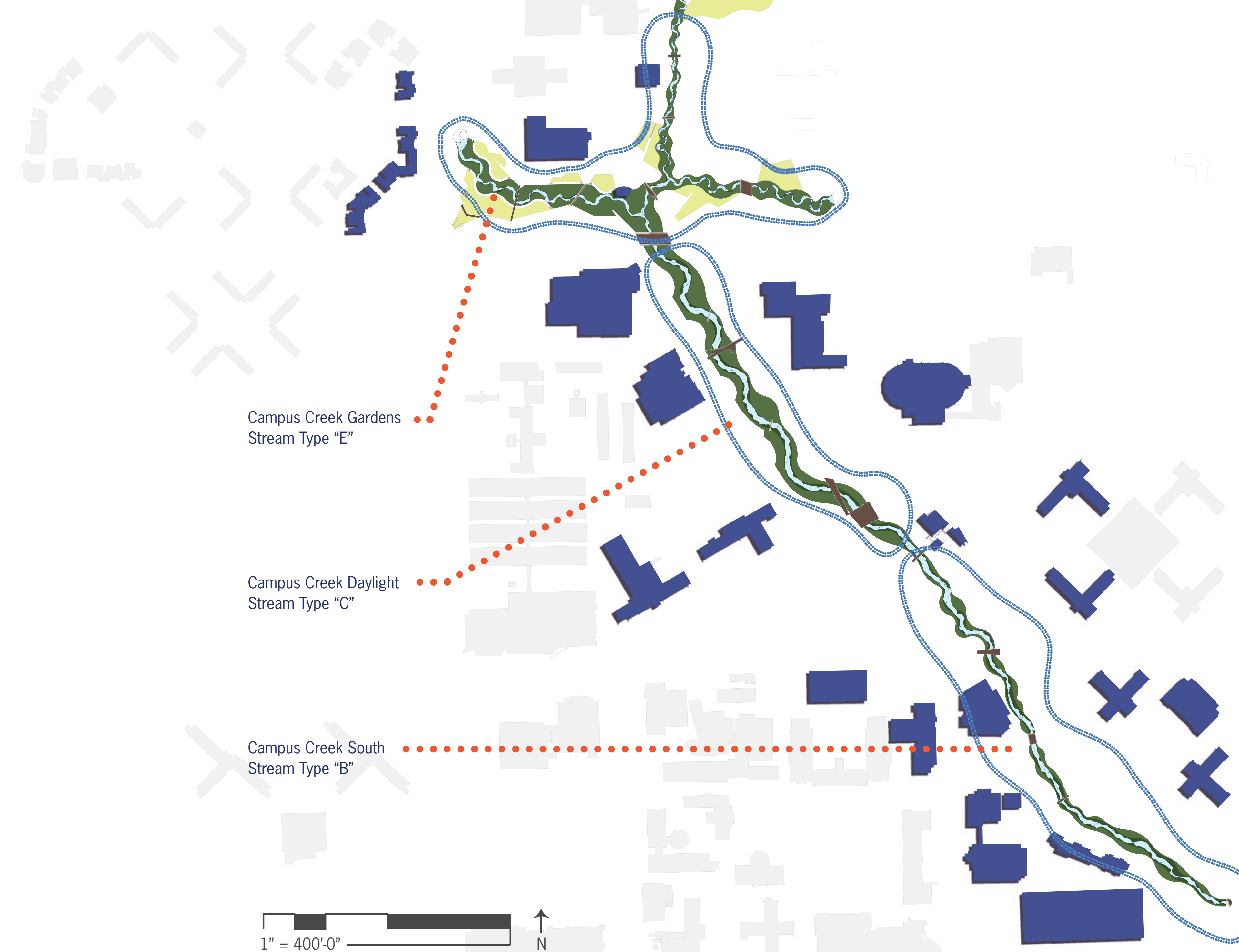


Figure 27 - Reach Definition (Meihaus 2009)

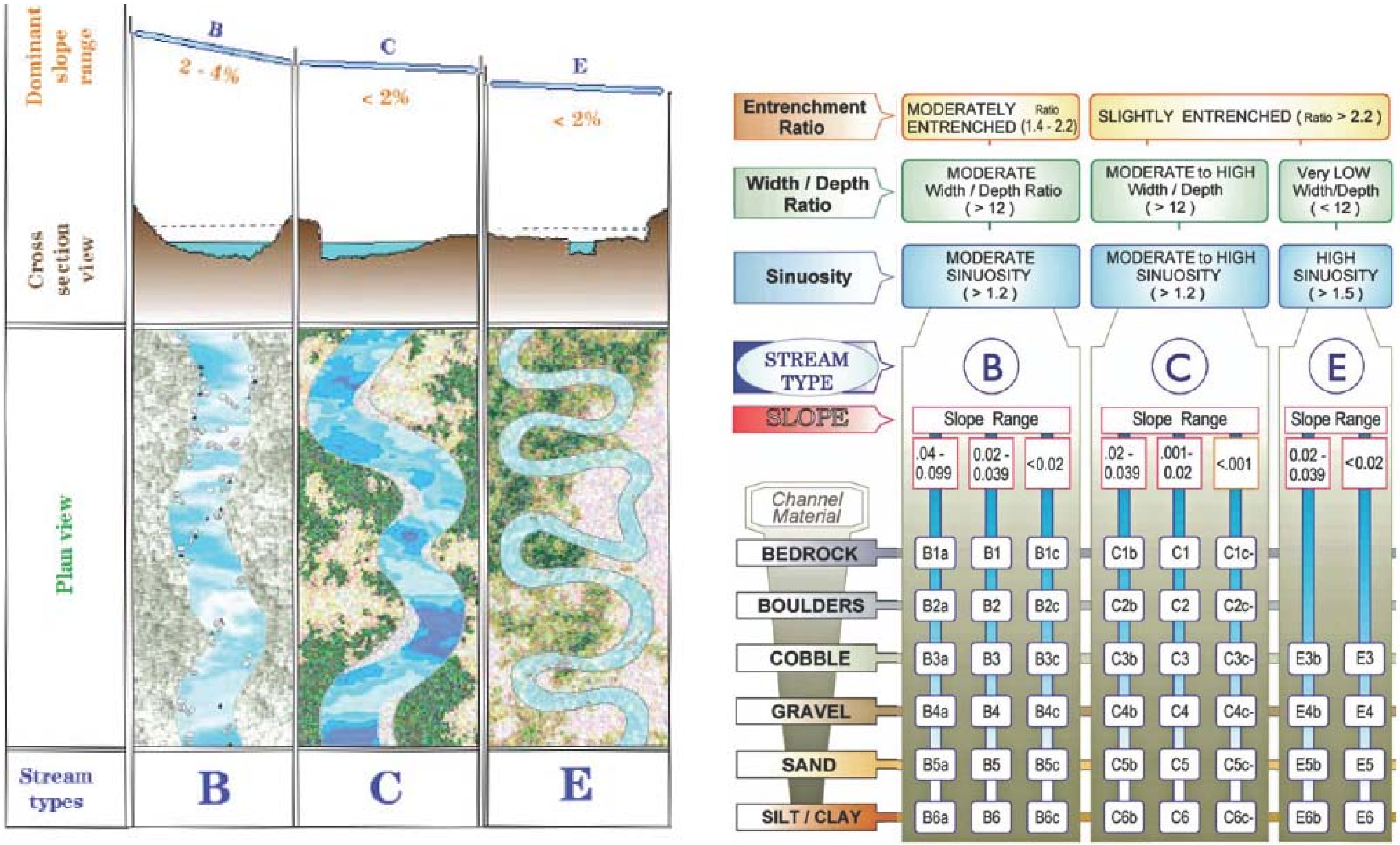


 Figure 28 - Adapted from Rosgen Stream Type Classification (Rosgen 2007, 11-6,7)

Channel & Floodplain Dimension Calculations

Contributing Area	(Q2) Two Year Storm (cubic ft./sec.) with R.I. adj. to Time of Concentration	(Q100) 100 Year Storm (cubic ft./sec.) with R.I. adj. to Time of Concentration	Channel Cross-Sectional Area (sq. ft.) = 65% of Q2 over 4 ft./sec.	Floodplain Cross-Sectional Area (sq. ft.) = Q100 over 2 ft. per sec.	Entrenchment Ratio	Width/ Depth Ratio	Radius of Curvature (ft.)	Sinuosity	Stream Channel Type for Contributing Area (approximately)
Catchment #1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Catchment #2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Catchment #3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Catchment #4									
	11.73	18.88	8	34	2.3	2	24	1.5	E
Catchment #5									
	206.76	353.32	33	176	2.3	2	20	1.5	E
Catchment #6									
	64.83	99.83	10	50	2.3	2	13	1.5	E
Catchment #7									
	160.34	246.9	72	360	2.5	12	72	1.3	C
Catchment #8									
	115.73	178.18	91	448	1.5	12	99	1.2	B
Catchment #9									
	67.99	106.11	101	501	1.5	12	102	1.2	B

Table 02 - Stream Type Calculations (Meihaus 2009)

Components of the Plan

Campus Circulation Planning

As a means of prioritizing for creek form and function within the channel and floodplain corridor on campus, substantial re-configurations to campus infrastructure are included in this proposal. Removal of roads, parking, and general infrastructure is carefully considered within an achievable range along each of the three reaches. Often in urban conditions, road and parking infrastructure are the most debilitating to stream systems in terms of increases in run-off, physical degradation of channels and constriction of floodplains. This proposal depicts an alternative organization and hierarchy of circulation within the campus creek corridor aimed at simplifying vehicular access and improving the overall pedestrian experience while creating and increasing a respectable buffer zone around the creek (Figure 29).

Major alterations to road alignment include Jardine Drive, Claflin Road, and Campus Creek Road, and Mid-Campus Drive. The plan is based around the removal of Mid-Campus Drive as a vehicular corridor. The current KSU Master Plan illustrates the removal of vehicular access between Mid-Campus Drive and Claflin Road, and removal of Claflin Road from Mid-Campus Drive to Denison Avenue. These are considerable changes not only to campus circulation but to the Manhattan street grid. Open vehicular access east and west across campus along Claflin Road is critical to connectivity with the urban grid of greater Manhattan and neighborhoods adjacent to campus.

As an alternative to the current KSU Master Plan, but consistent with its goals of providing an improved pedestrian experience on Campus, Mid-Campus Drive has been replaced with a pedestrian boulevard, while alignment of Claflin Road has been maintained although scaled down for lower volumes of vehicular traffic (Figure 29).

This plan maintains a high level of service, emergency, and parking access east and west across campus, while north and south circulation is oriented around pedestrian movement laterally along the Campus Creek corridor. Replacement of Mid-Campus Drive extends south of Claflin Road to the south side of the new Leadership Studies building and the academic core of campus. These drives are unnecessary in a campus environment except to access parking and building service areas. Parking along the former Mid-Campus Drive and fronting Dole Hall and Call Hall have been relocated for the day-lighting of Campus Creek. All campus buildings maintain their original service access, and entry to parking lots have been adjusted according to retrofit storm-water best management practices and channel modification described later in more detail for each reach.

Additional circulation enhancement planning includes the straightening of Jardine Drive between Mid-Campus Drive and the main dormitory parking lots. This provides more direct access to adjacent parking and service areas while enlarging the buffer around the creek and maximizing the area for storm-water detention wetlands within the new Campus Creek Gardens. Both Jardine Drive and Claflin Road intersections with Campus Creek are now bridged and span a minimum of the floodplain width to minimize physical constraint on the creek system. The drive north of the new Leadership Studies building has been replaced with a pedestrian walk and bridge. Campus Creek Road has been re-directed away from the southern edge of the channel and into a parking structure to be built north of Justin Hall as shown in the current KSU Master Plan.

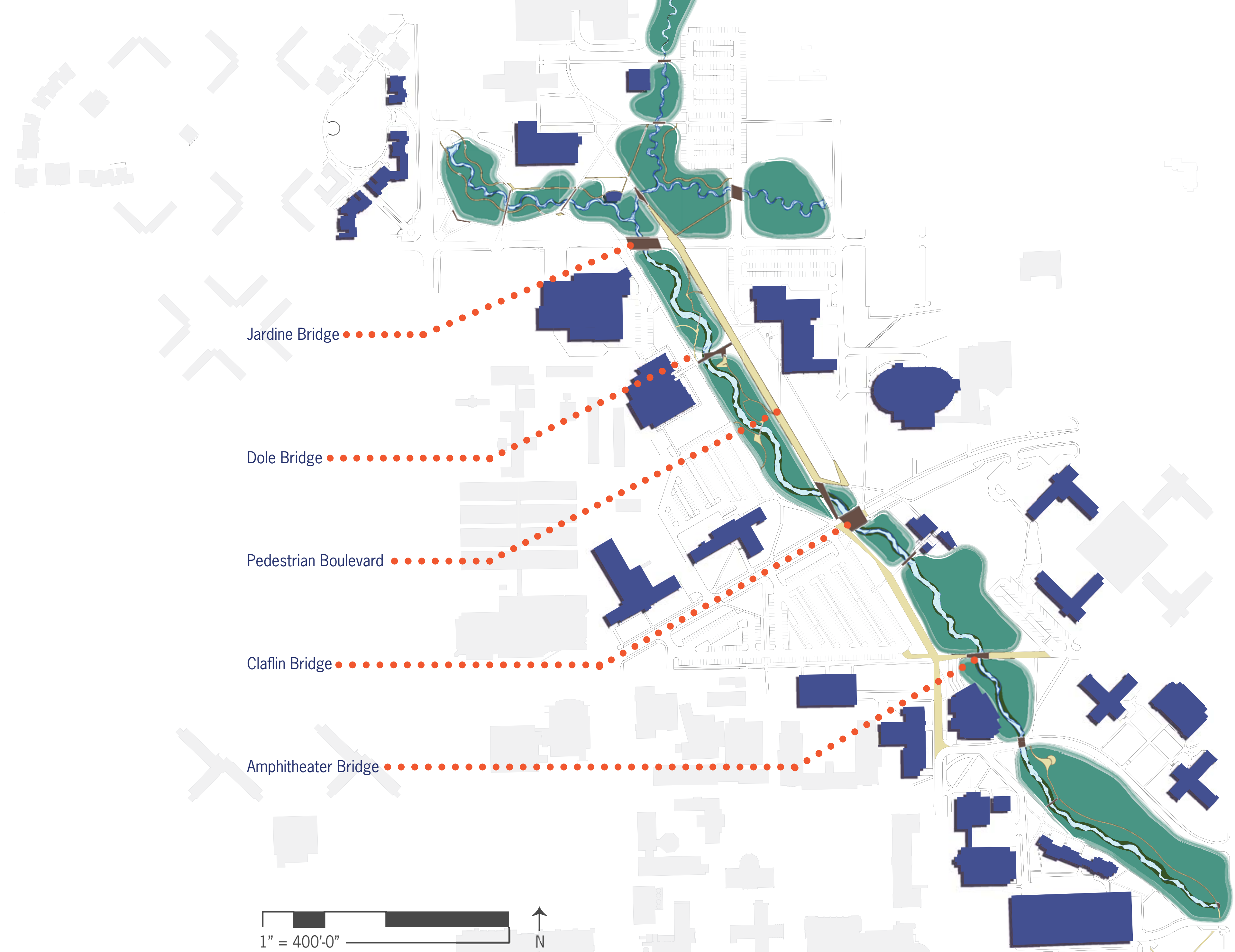


Figure 29 - Campus Circulation (Meihaus 2009)

Components of the Plan

Gathering & Open Space Planning

Improvement of the Campus Creek corridor makes available programmable open space for educational and social gathering. With the creek serving as the linear organizing element between new and old spaces, an opportunity presents itself to give people access to the creek and a renewed corridor experience. Smaller seating nodes enhance passive function from the Jardine to N. Manhattan Avenue. Larger spaces include a large amphitheater on the north side of the new Leadership Studies building (Figure 30), and an outdoor pavilion within the floodplain of the Campus Creek Gardens. These access points and active spaces are distributed evenly between all three reaches of the creek.

Storm-water BMP Retrofit Planning

As noted, the primary goal in watershed improvement planning is to reduce peak run-off by infiltration first, and second, by volume storage. Achieving a stable plan, profile, and channel cross-section for Campus Creek would be impossible without a reduction of the quantities of run-off from impervious surfaces on campus (Riley 1998).

Incorporated into this proposal are locations for potential storm-water best management practices, or BMP's (Figure 31). In many cases these proposed BMP's are retrofitted into existing roads and parking lots, and calculated in size to account for the run-off from their neighboring impervious surfaces (Figure 33). Parking lots accessing Claflin Road, serving Ford Hall, backing Umberger Hall, and on the east side of the Vet. Med. Center have each been re-designed to accommodate sufficient bio-retention swales and rain-gardens. Planning for the implementation of these storm-water management practices intends to disconnect the hydrology of the creek from excess run-off by retaining it and allowing it to infiltrate into the soil (Figure 32).

Curb and gutter systems along parking lot edges, as well as Claflin Road and Petticoat Lane have been replaced with filter strips, level spreaders, and vegetated swales (Figure 31). This strategy reduces rates of run-off directly into the creek, and reduces the load on deteriorating storm-water infrastructure, and in some cases eliminates the need for storm-water pipes on campus at all.

In addition, permeable paving techniques have been introduced with the pedestrian boulevard replacement of Mid-Campus Drive, and on secondary and tertiary pathways within the floodplain of all three reaches of the creek (Figure 31). These areas are limited to pedestrian areas where impact on fragile infiltration systems is decreased. Pedestrians, as opposed to users of vehicles on campus, have a closer experiential relationship to the detailed scale of permeable paving systems. Strategic use of permeable paving is one way to bring more recognition of the creek to campus users, and substantiate the presence of urban hydrologic function.

Landscape Types & Vegetation

This Comprehensive Plan recognizes the necessity to maintain a formal academic setting, but strives to introduce and expand upon a naturalized character within the creek corridor. Management of native and riparian vegetation is crucial to maintaining a healthy stream and to mitigate for constituents and excessive storm-water flows from urbanized areas. Planting the channel banks and

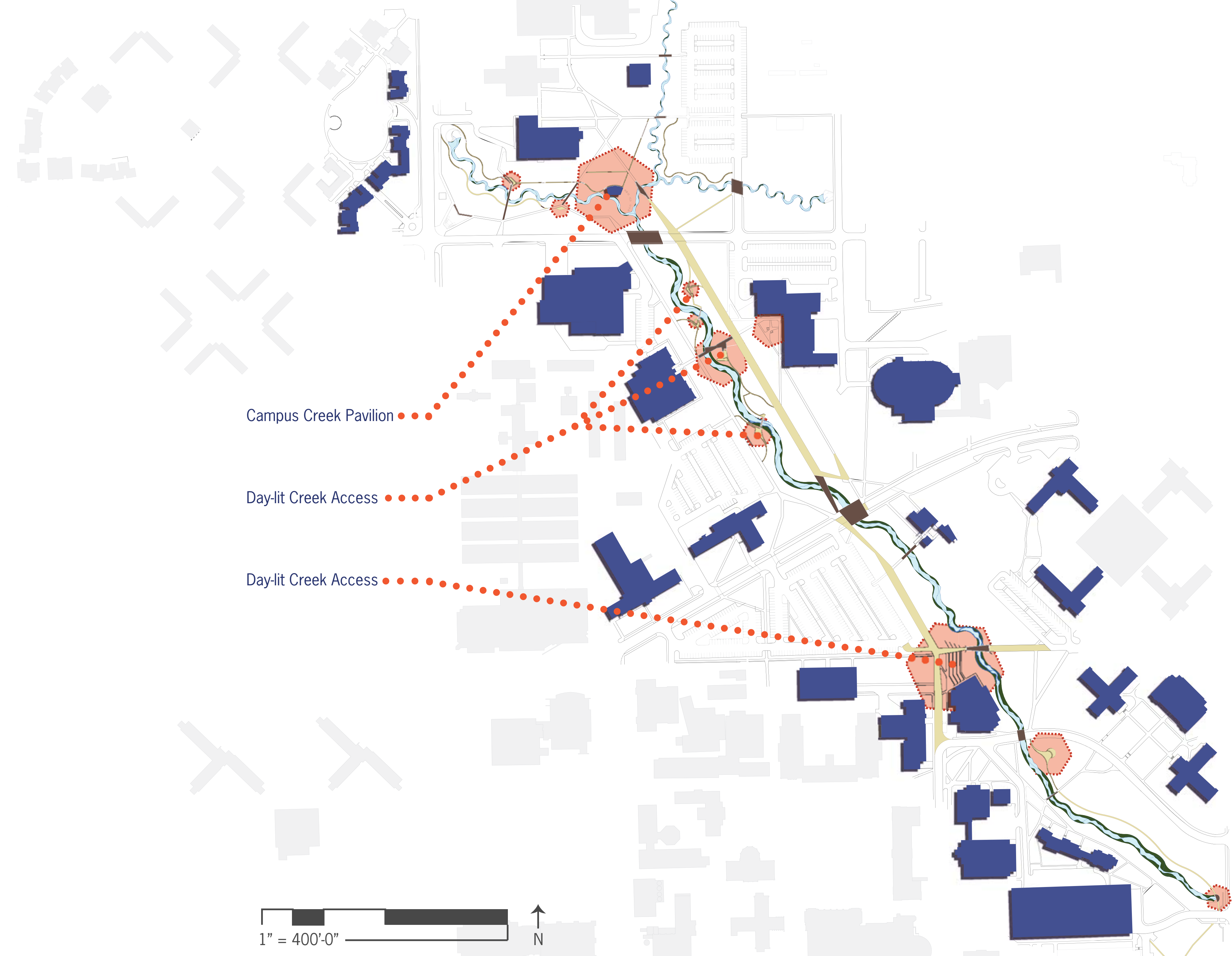


Figure 30 - Social Gathering (Meihaus 2009)

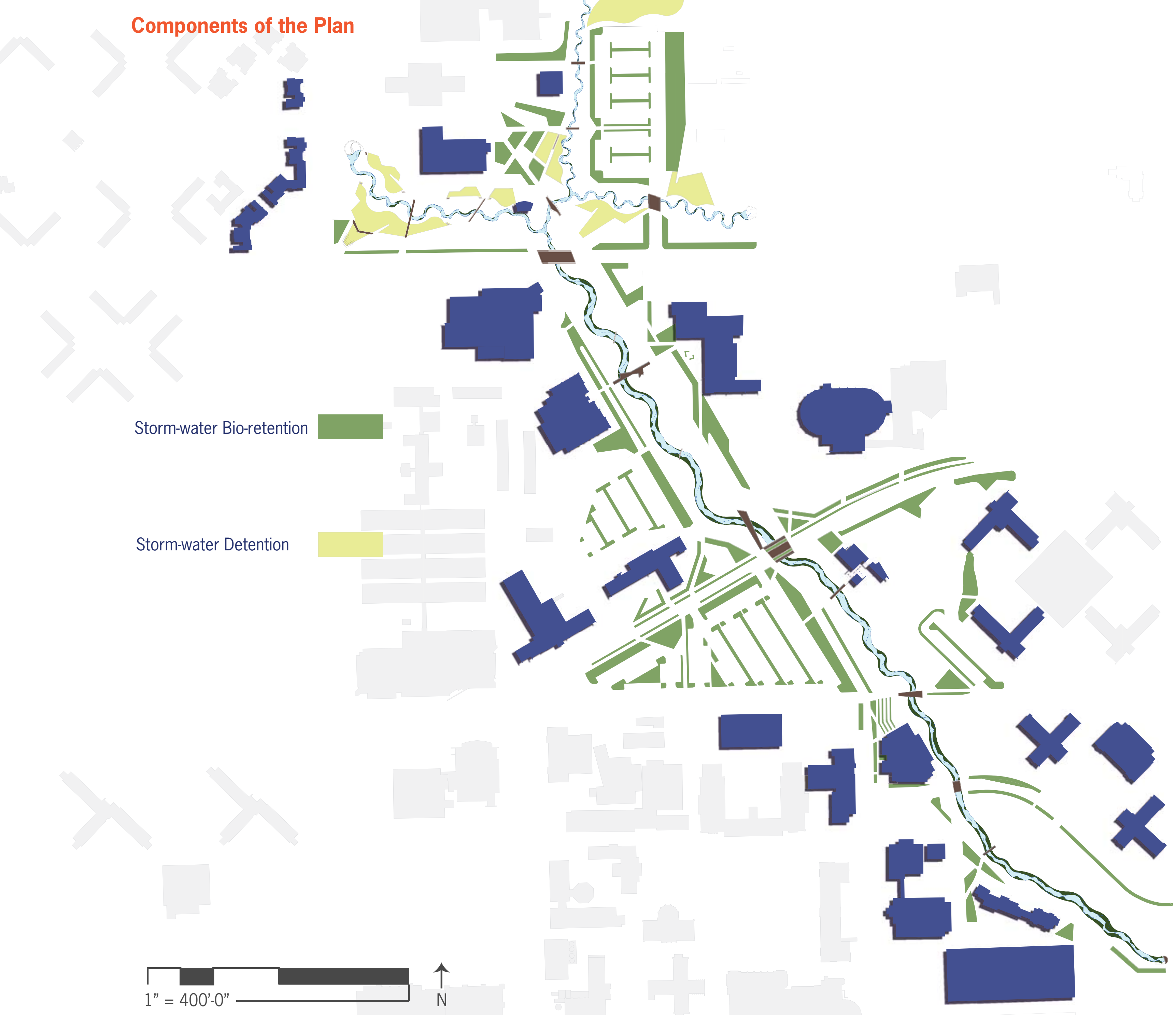


Figure 31 - Storm-water BMP's (Meihaus 2009)

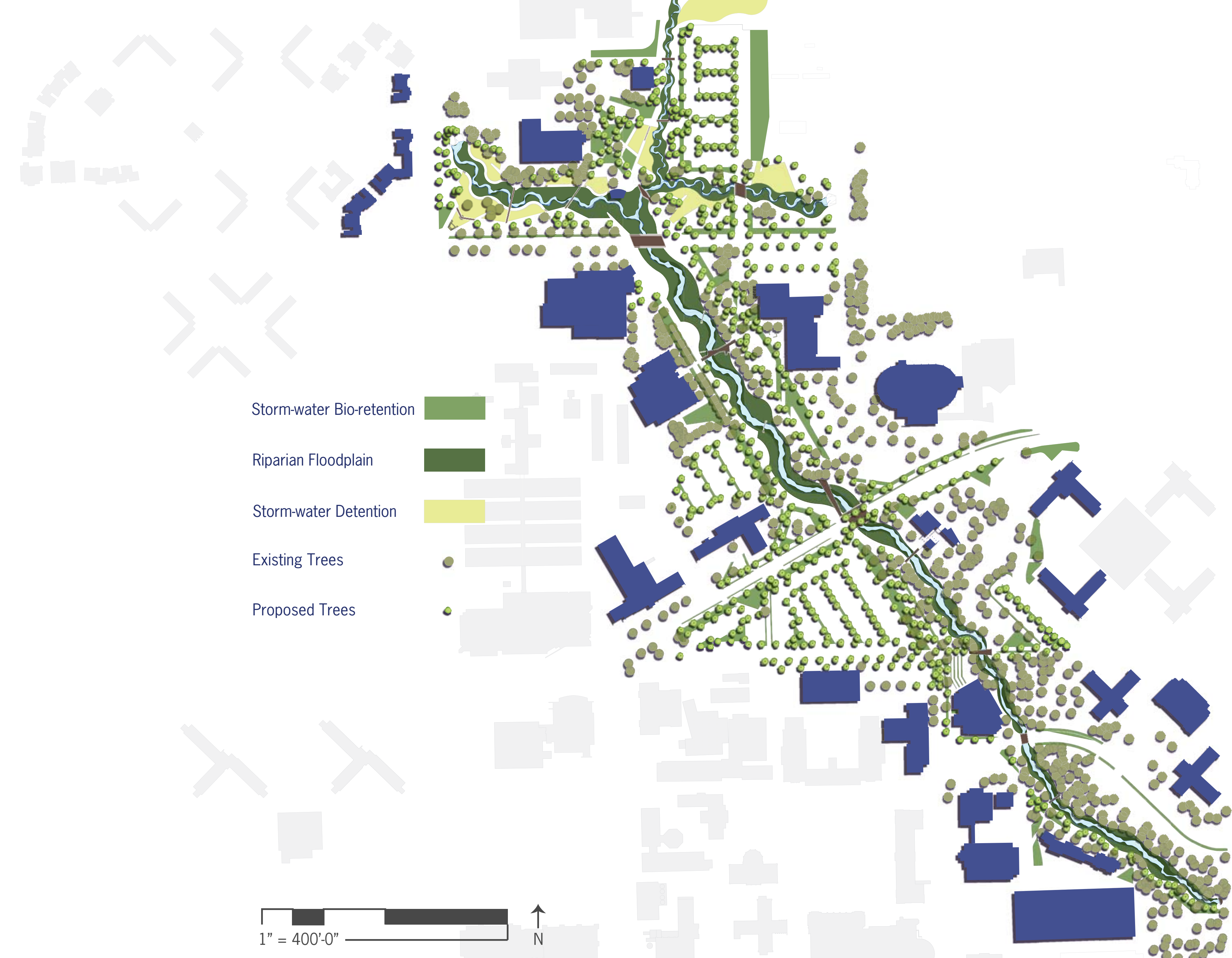


Figure 35 - Landscape Types (Meihaus 2009)

floodplain with native trees, shrubs, forbs, sedges, and rushes improves the physical channel stability as well as water quality and biological habitat (Figure 35)

Informally planted areas of the creek are countered by a formal edge of shade and street trees. BMP's, riparian floodplain establishment, and detention areas limit use of turf-grass, ornamental, or non-native plantings for open space within the corridor. Planting of large woody species throughout the corridor builds off of the existing character of Campus Creek South where groves of large trees have already been established matured over time (Figure 33).

The only exception to a management plan for a dense woody riparian corridor is the vegetation composition within the detention areas proposed for Campus Creek Gardens. These detention areas are made up of strictly wet-mesic prairie forbs, sedges, rushes, and grasses native to the Flint Hills Eco-region. This is for purposes of establishing a native aesthetic for the garden, and to create functional temporary storage for flood level flows into the creek (Figure 35).

Successful implementation of this proposal in terms of landscape types and vegetation will require management for native plants around campus creek. While this may require more maintenance for the removal of invasive and non-native species, the level of maintenance due to turf grass management has been significantly reduced within the Campus Creek Corridor (Figure 36).

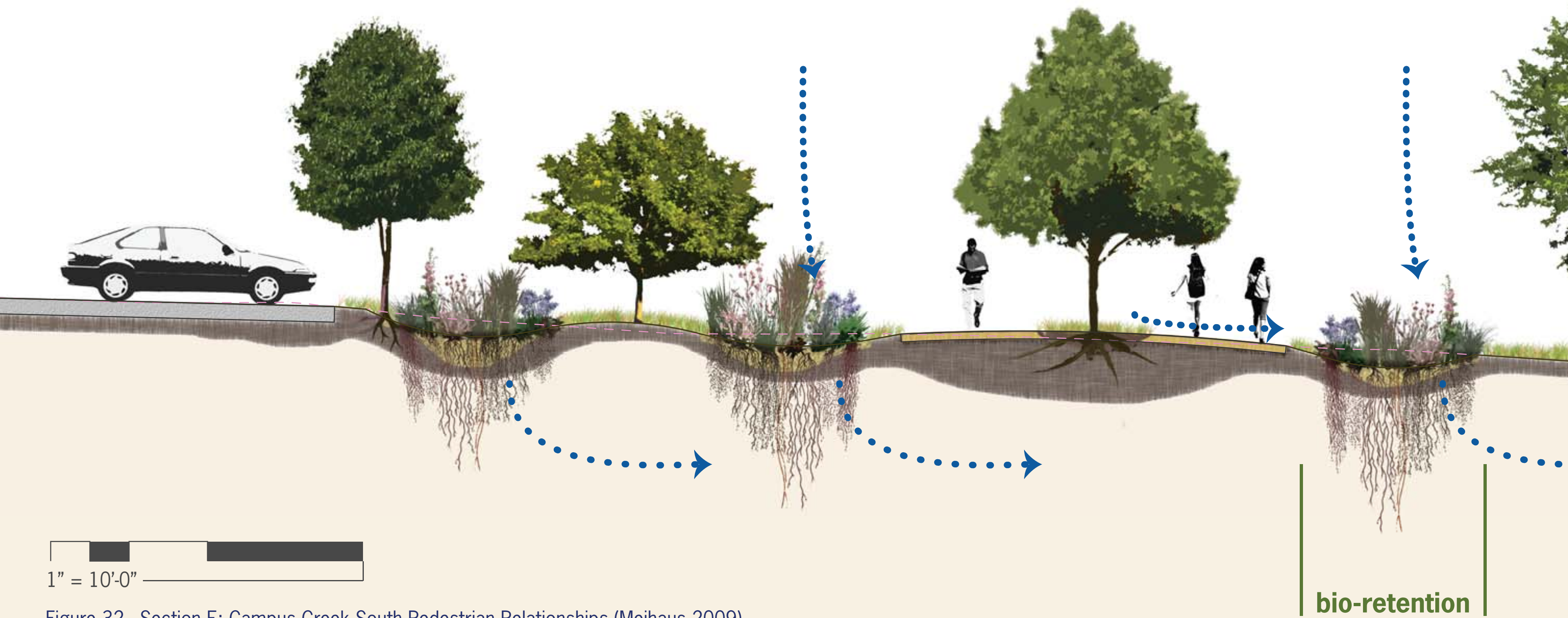


Figure 32 - Section E: Campus Creek South Pedestrian Relationships (Meihaus 2009)

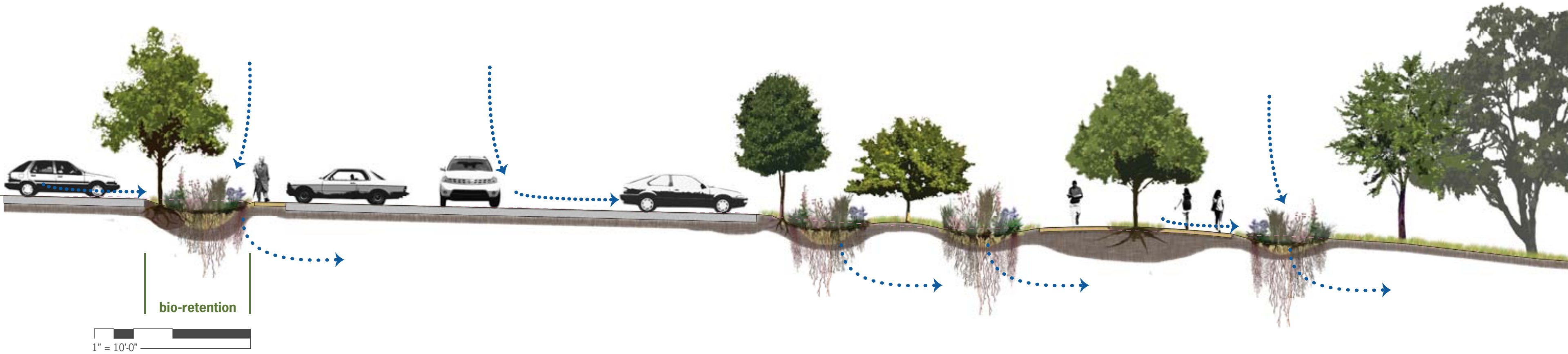
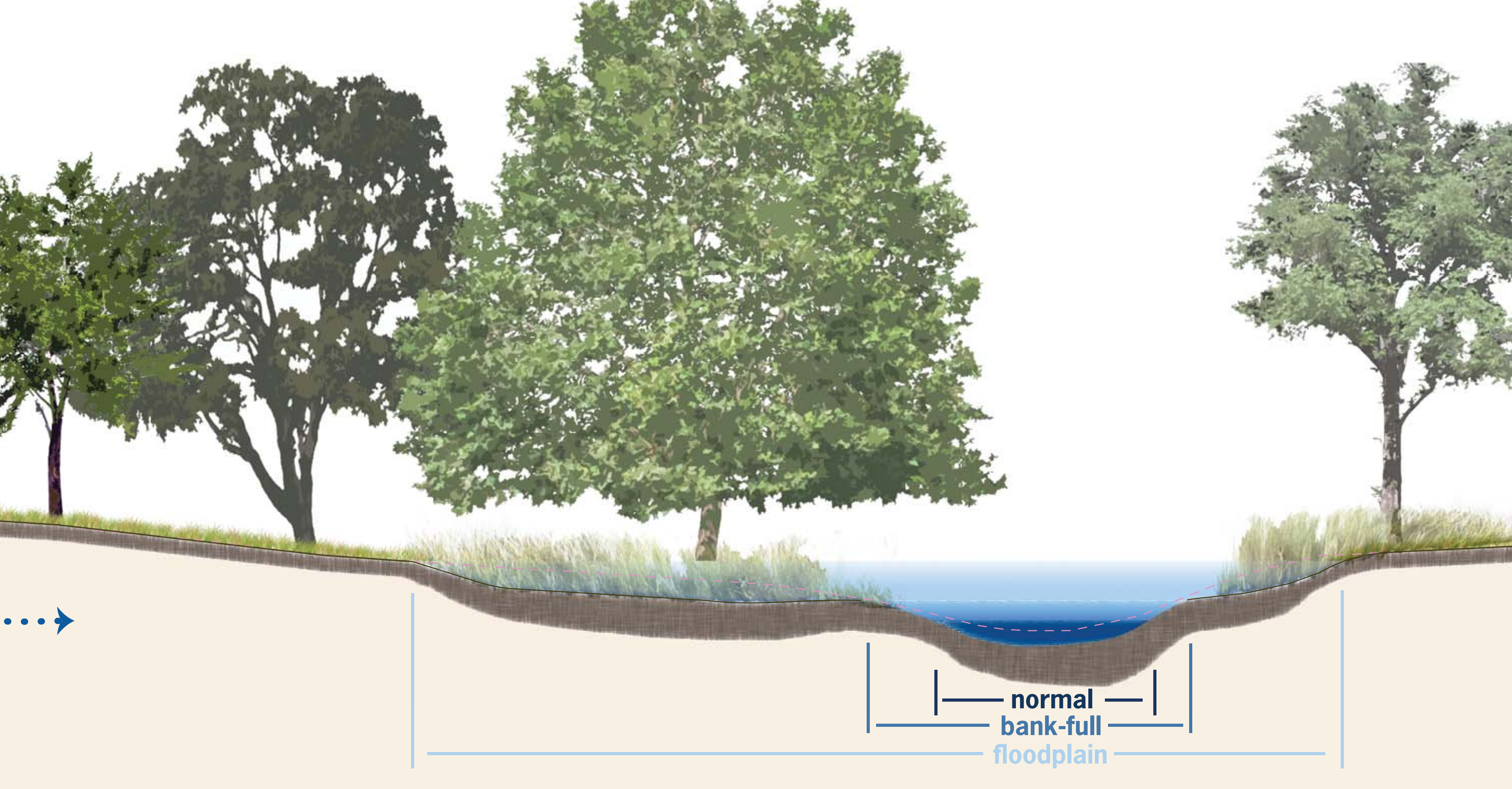


Figure 33 - Section E: Typical Parking and Walkway Storm-water Retrofit (Meihaus 2009)



Components of the Plan

Figure 34 (down) - Existing View Down Pedestrian Boulevard (Meihaus 2009)

Figure 36 (right) - Proposed View Down Pedestrian Boulevard (Meihaus 2009)

Campus Creek Gardens

Campus Creek Gardens is an alternative concept for expansion of the current KSU Gardens (Figure 37). The current KSU Master Plan calls for expansion of the formal gardens north of the Conservatory to Jardine Drive, and then expanding into existing open space south of the Vet. Med. Center. KSU Master Plans depict several retention type ponds with ornamental fountains, waterfalls, and other various water features. These features ignore the existence of any channel or degree of hydrologic function on this site. Retention ponds at this site will simply cause a higher rate of run-off into the lower reaches of the creek, exacerbating the problem at hand.

The hydrologically sensitive proposal made in this project and report involves a native and naturalized garden amenity on campus as an alternative to high maintenance and inwardly focused formal gardens. Campus Creek Gardens prioritizes planning and design around the needs of the creek and conceptual design of a stable channel and active floodplain (Figure 38).

The Campus Creek Gardens proposal optimizes available space for restoration of a stable Type “E” channel, functioning floodplain, and detention volume storage of intense flows from the northern catchment areas on campus (Figure 39). Channel bank-full dimension are sized to convey a two year 24 hour storm. Floodplain dimensions are calculated for a 100 year event. Detention areas are sized with the potential to temporarily contain a total discharge volume of a 2 year, one hour storm typical of the region. These wet-mesic prairie areas are reduce run-off rates downstream through infiltration and temporary storage over period no longer than 48 hours. Figure 39 depicts the levels at which volumes of water occupy the normal channel, bank-full channel,

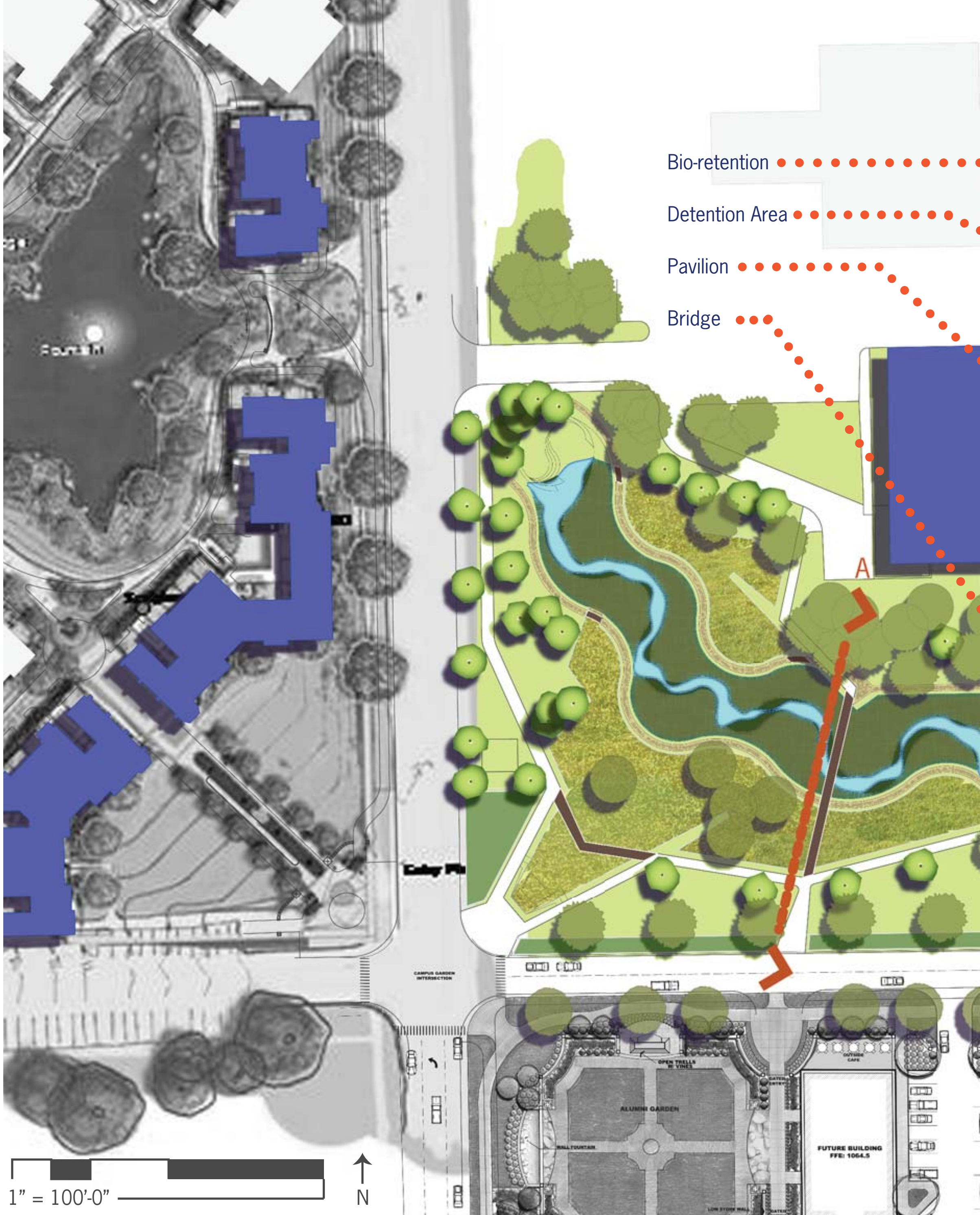


Figure 37 - Campus Creek Gardens Plan (Meihaus 2009)


B

floodplain, and detention areas typically found in the Campus Creek Gardens proposal.

The channel, floodplain, detention areas, and rain-gardens catching storm-water run-off from the Vet. Med. center comprise a native garden atmosphere and character for the site. Campus Creek Gardens is intended to be a leisure space and extension of the KSU Gardens experience. A landscape comprised mostly of grasses devoid of tall vegetation or visual barriers creates an open vista across the gardens and its features (Figure 40).

Pedestrian circulation through the site also provides efficient movement between the Vet. Med. Complex, Jardine Apartments, and strong connections down the campus creek corridor into the academic core of campus. The existing main pedestrian bridge connects to the new pedestrian boulevard to the south. Additional stilted walkways step lightly across the creek above the floodplain (Figure 38). A series of closed and open circulation loops are created by permeable walkways placed on narrow berms which separate the certified riparian floodplain from the designed detention areas (Figure 39).

Besides designated passive seating spaces along the pathways and channel, active space is concentrated around an outdoor pavilion and adjacent sloping lawn (Figure 40). This pavilion, featuring an extensive green-roof demonstration with solar orientation, lies within the active floodplain of the creek. This allows for various groups or individual users to experience the edge of the channel without restriction from railings or retaining walls while sheltered from either hot or rainy conditions. The open lawn area to the north of the pavilion is the only space in on the site capable of accommodating larger groups of people, and can serve a variety of functions and events for the university in a native garden atmosphere.

As opposed to an inwardly focused and isolated garden concept, Campus Creek Gardens is an integral part of a larger effort to restore an uninterrupted and stable hydrologic system to the creek. The gardens functions to protect the lower reaches of the creek from major flood flows. This proposal introduces an entirely new type of landscape and amenity to the K-State Campus and surrounding community (Figure 41).

Figure 38 - Section A: Campus Creek Gardens E Channel and Floodplain (Meihaus 2009)

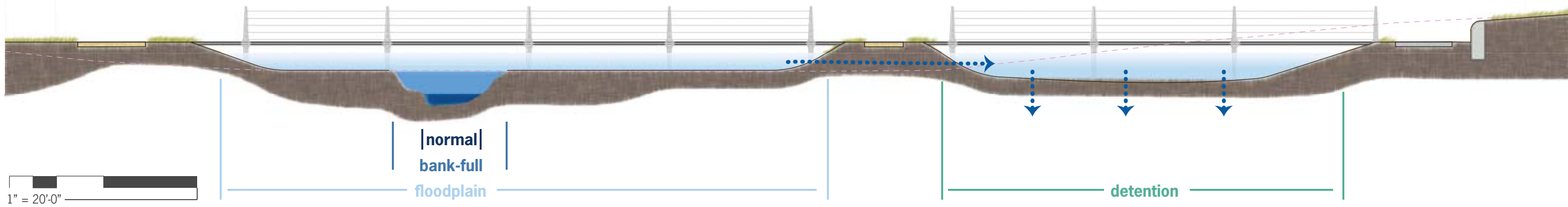


Figure 39 - Section A: Type E Channel, Floodplain, and Detention Function (Meihaus 2009)

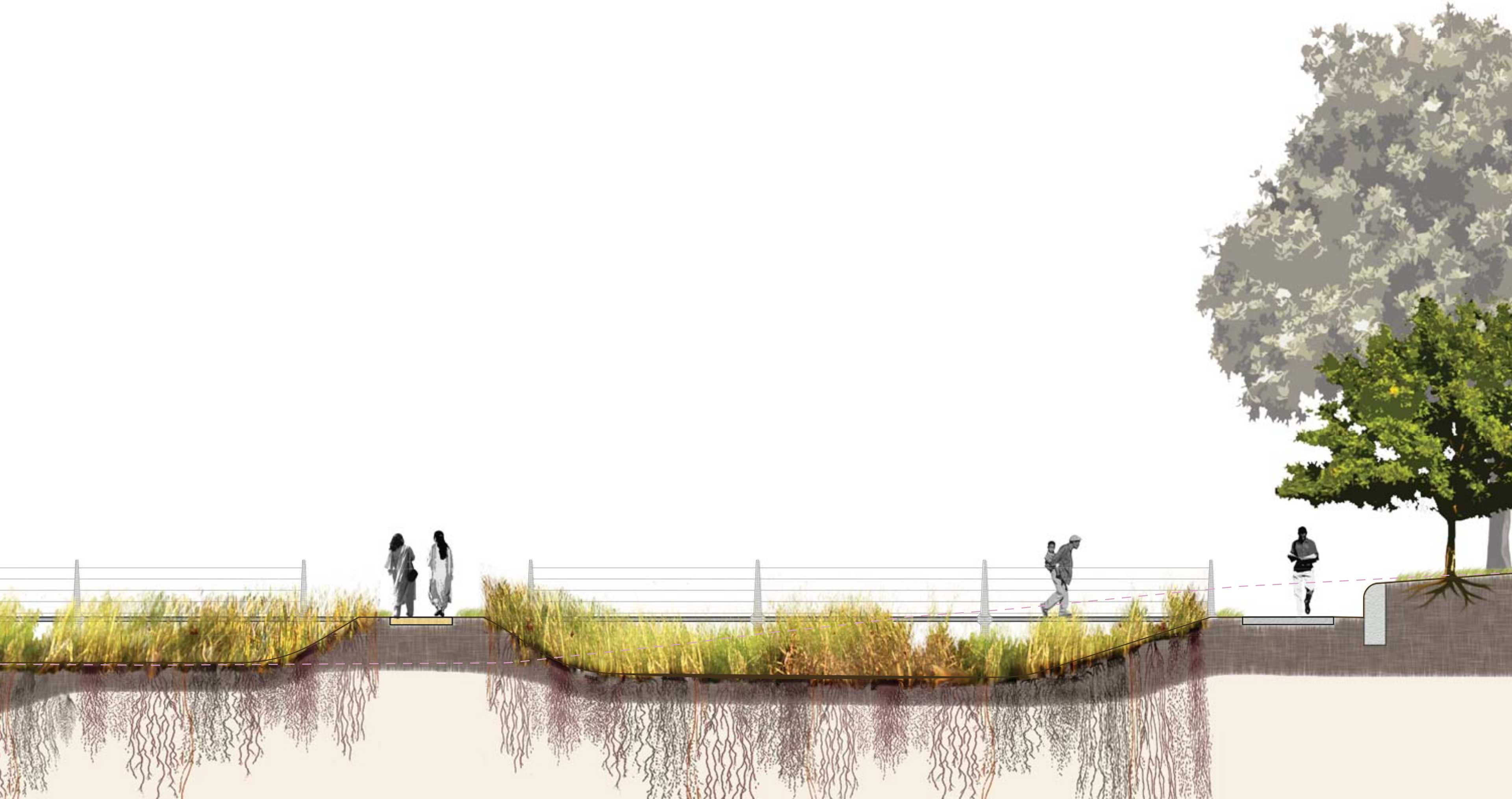
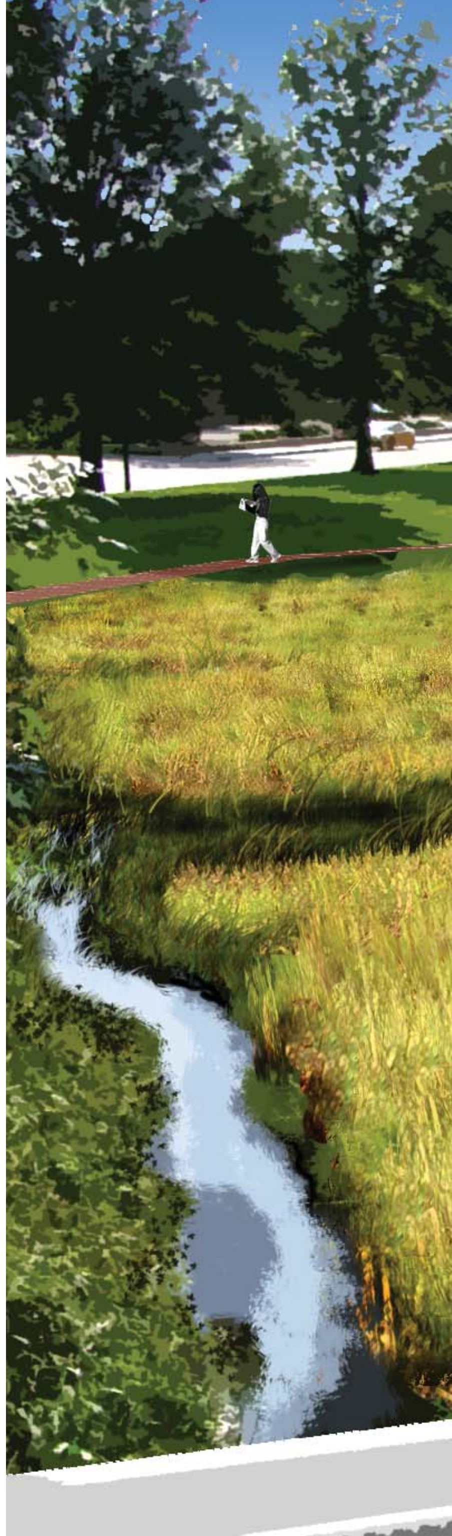


Figure 40 - Section B: Campus Creek Gardens and Pavilion Relationships (Meihaus 2009)

Campus Creek Gardens

Figure 41 - View Across Campus Creek Gardens (Meihaus 2009)



Campus Creek Daylight

Although not programmed as a major social destination on campus, the Daylight reach proposed for Campus Creek is in many ways the most significant improvement within the entire proposal (Figure 42). Complete reconstruction of over 1200 feet of channel is required to connect the grade from the Campus Creek Gardens to the existing channel on the opposite side of Claflin Road. This new channel and floodplain are the hydrologically sensitive alternative to current dysfunctional culvert systems and extensive storm-water infrastructure.

Channel reconstruction of this kind requires reintroduction of all major components of a natural system: riparian floodplain, terraces, bank-full benches, pools, riffles, naturally designed channel type, width depth ratio, entrenchment ratio, calculated gradient, and sinuosity (Rosgen 1997). These features replace the need for storm-water pipes and culverts currently diverting the creek beneath drives and parking areas fronting Dole Hall. Day-lighting the creek also eliminates the need for additional storm-water infrastructure necessary to mitigate for increases in run-off from these impervious areas. This reach is critical to creating a continuous Campus Creek corridor and illustrates the most ideal alternative to current and future piping of the channel (Figure 43). Without the reconstruction of this section of the creek, the entire corridor will continue to show the worst signs of urbanization and instability.

Run-off calculations from catchments four through seven were used to determine bank-full channel dimensions and a type ”C” channel classification (Figure 44). This channel type is larger and less sinuous than the type “E” upstream, and is necessary to convey higher intensities of run-off while retaining its stability.

Floodplains for the channel were maximized in width as allowed by site constraints on either side. Mature trees to the north of the channel were retained for aesthetic purposes along the new pedestrian boulevard (Figure 43). Existing steam pipes also along the north edge of the day-lit channel at the intersection of Claflin Road have determined the edges of available floodplain width beneath the bridge.

The new day-lit corridor not only gives priority to the creek, but is oriented toward pedestrian use and connections across campus. The day-lit channel represents a hydrologic transition between Campus Creek Gardens and the Campus Creek South reach. Similarly the main pedestrian boulevard along the former Mid-Campus Drive transitions circulation from two major parts of campus. Bridges are illustrated to minimally interfere with a naturalized corridor while maintaining positive circulation throughout campus. As opposed to culvert piping, connection the campus across the creek with bridges reduces constriction of bank-full and flood flows down the creek.

Mid-Campus Drive has been replaced by a pedestrian boulevard along its original axis parallel to the east edge of the day-lit creek (Figure 42). A bridge on the south end of the boulevard spans the creek and continues south to the academic core of campus. Perpendicular to the pedestrian bridge is Claflin bridge (Figure 45). Figure 46 illustrates ideal conditions for spanning the new day-lit channel and allowing flood levels in pass beneath the bridge without constriction.

A seating area fronting the entrance to Call Hall is linked to the entrance of Dole Hall with another bridge over the creek (Figure 43). This bridge features access down into

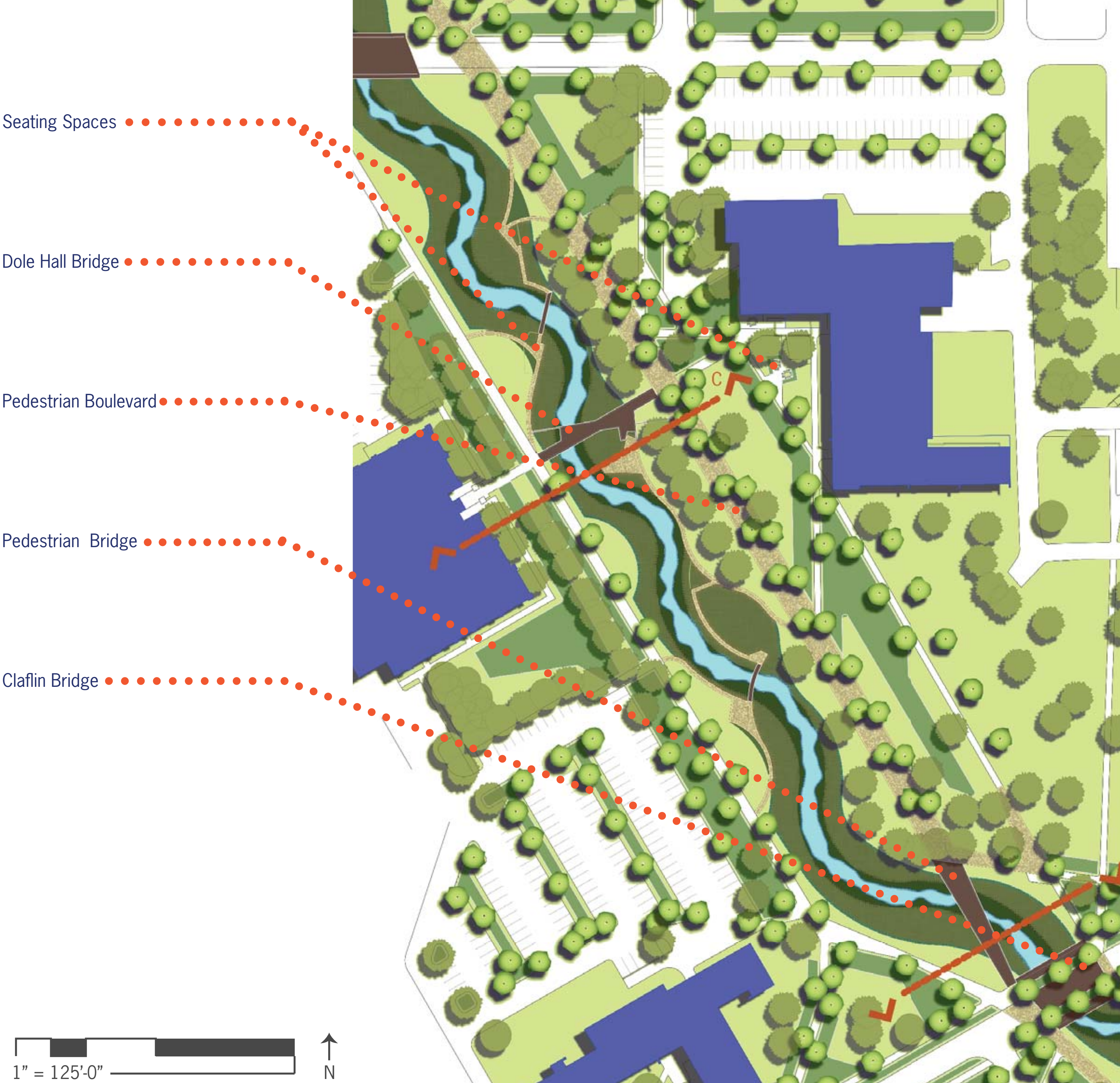


Figure 42 - Campus Creek Day-lit Reach (Meihaus 2009)

the day-lit channel and a small space lying in the floodplain. Pathways in the floodplain are meant to have minimal impact on the creek, with limited room for small groups to tread of permeable paving. The concept for this reach includes bio-retention swales along walkways running parallel to the new channel (Figure 43). Establishment of a stable day-lit channel will depend on an overall reduction of run-off, as well as management for native riparian vegetation along the banks and within the floodplain.

Figure 44 (right) - Section C; C Type Channel, and Floodplain Function (Meihaus 2009)

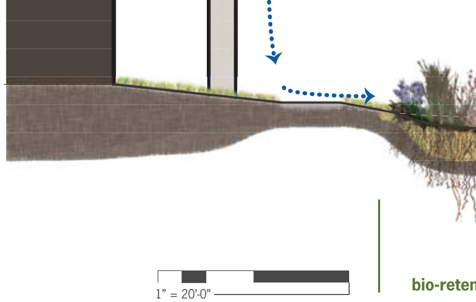
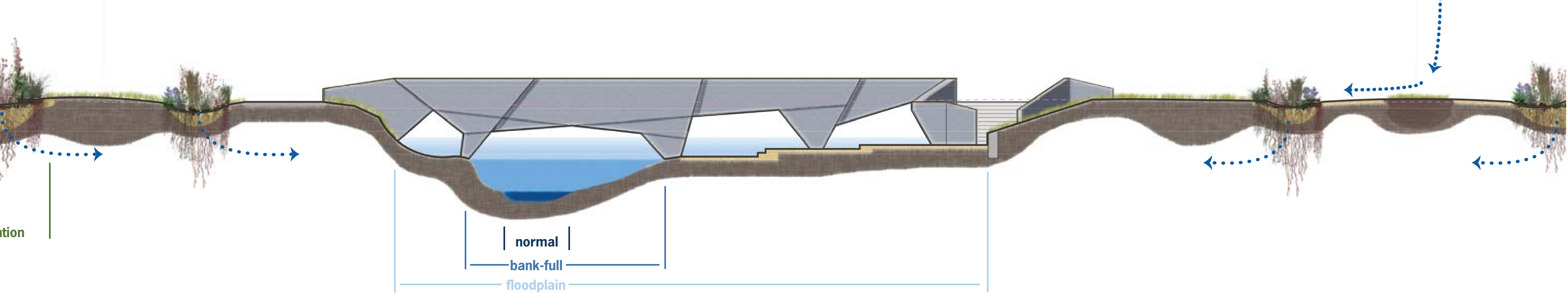


Figure 43 (below) - Section C: Mid-Campus C Channel, Floodplain, and Bridge Design (Meihaus 2009)


tion
normal
bank-full
floodplain

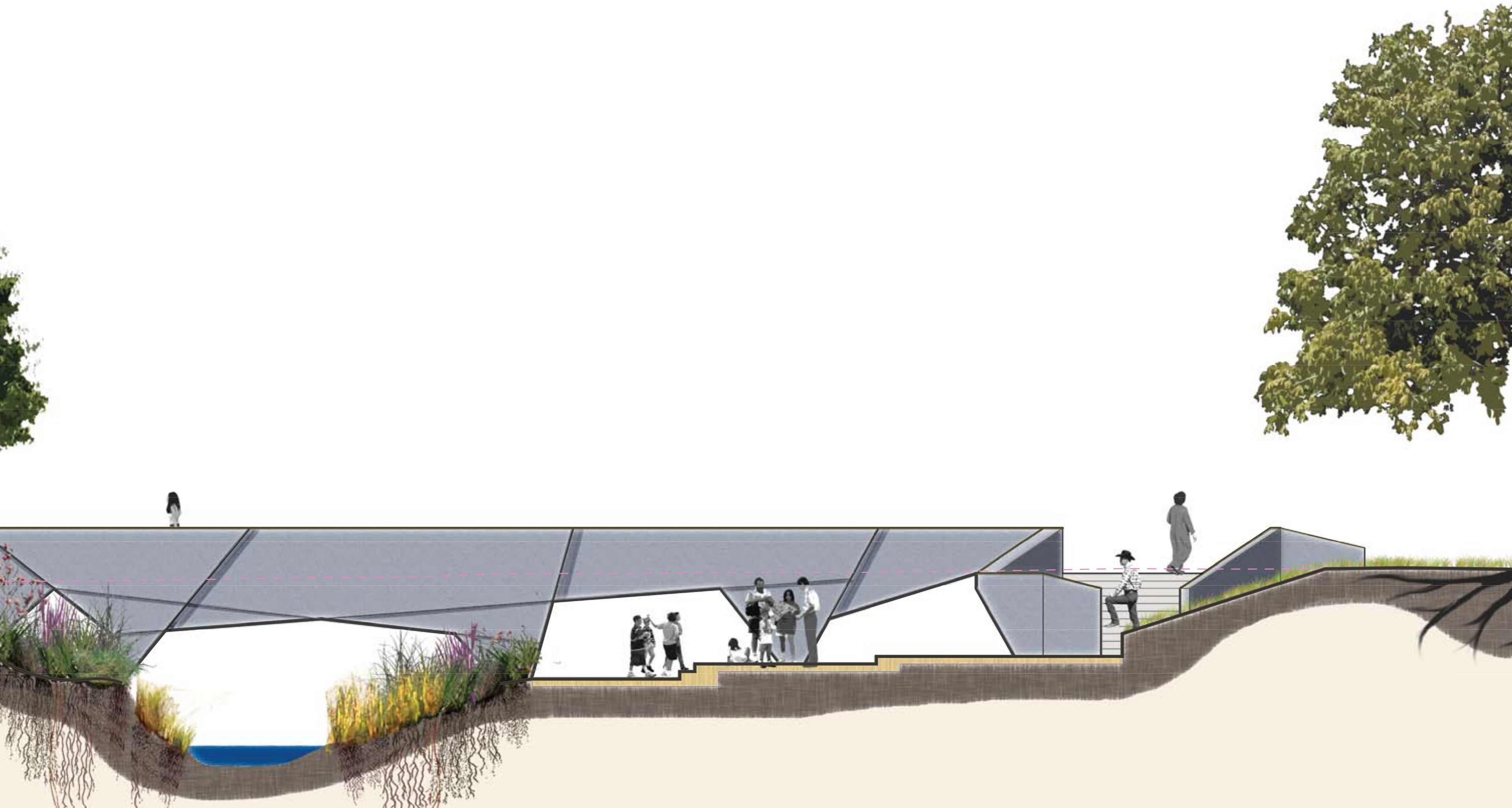
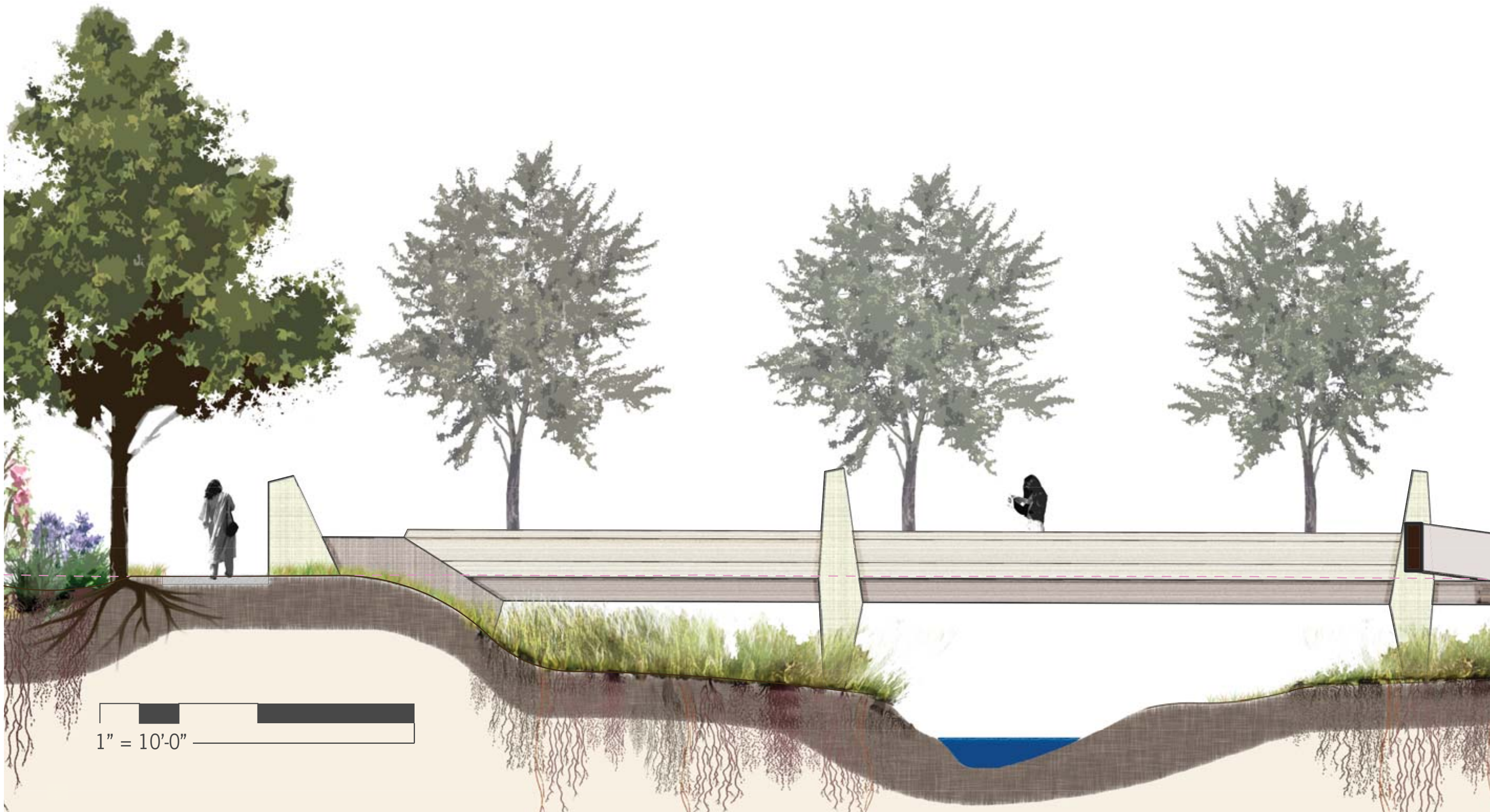


Figure 45 - Section D: Claflin C Channel, Floodplain, and Bridge Design (Meihaus 2009)



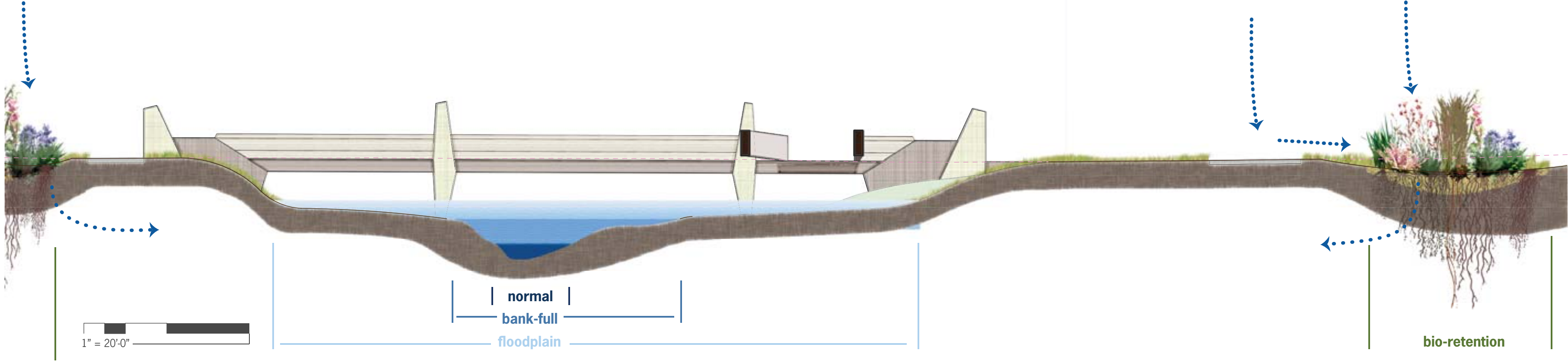


Figure 46 - Section D: C Channel, and Floodplain Function
(Meihaus 2009)

Campus Creek South

Campus Creek South contains the least amount of alterations to the creek, but is equally important to a wholistic approach to improving the Campus Creek corridor (Figure 47). Constraints for channel manipulation and improvements regarding the campus are due to the historical nature of this area of campus: large established woody vegetation, sanitary sewer and steam pipes lateral to the creek, and the outfall of Campus Creek into storm-sewers beneath N. Manhattan Avenue and Bertrand Street.

A large parking structure just north of Justin Hall is part of the current KSU Master Plan. This garage presents an opportunity to remove Campus Creek Road and substantially increase the buffer zone on the southern edge of the creek (Figure 47). Through traffic along this section of the creek is unnecessary, drives are only required for service access and for the eventual parking structure. Even without the construction of the garage, the current organization of vehicular traffic in the corridor is excessive, and removal of Campus Creek Road will enhance a positive walking environment.

Construction is currently underway on a new Leadership Studies building and unfortunately in close proximity to the west edge of the creek. While the building replaces a surface parking lot, construction operations are already responsible for removal of several old growth oak and hackberry trees along the channel. The main concern for this section of the creek is restriction of any floodplain recovery and the need for bank-stabilization to mitigate excessive erosion activity. Since the building is already under construction, this proposal forfeits any chance to site Leadership Studies in a location more sensitive to the creek.

Recommendations for designing a stable channel are to design for a type "B" and a discontinuous floodplain (Keane 2009). Intermittent opportunities for floodplain terraces exist between groves of large oak and sycamore trees (Figure 48). Managing the corridor for riparian vegetation is crucial to improving the ability of the channel to handle large flows from the entire sub-watershed. The current outfall structure drops several feet down an algae covered concrete ramp and into a large box culvert. The elevation of the top lip of the outfall retains a standing pool of water and fine bed sediment several hundred feet up the channel. Removal and or lowering of this weir-like structure would drain most of the creek during dry periods.

Management of vegetation within the channel is crucial to ensure proper conveyance of sediment and water quantities during large storm events. There is a need and desire to maintaining the current overhead canopy for shade as well as aesthetics (Figure 49). Many of the changes to this reach concern management strategy and maintenance issues as opposed to re-design.

As a means of mitigating for additional run-off from the roof of the new Leadership Studies Building, an amphitheater design concept to the north includes storm-water collection and infiltration. Figure 50 illustrates the integration of vegetated infiltration between several rows of seating walls and walkways. The lowest level is the stage area, which actually lies in the floodplain of the creek, allowing water to temporarily occupy the space as an off-channel terrace. Figure 51 also shows the elevation concept for a smaller pedestrian crossing just to the north of the amphitheater. This bridge lies low and tight to the edges of the creek, providing another of many types of pedestrian relationships to the creek (Figure 51).

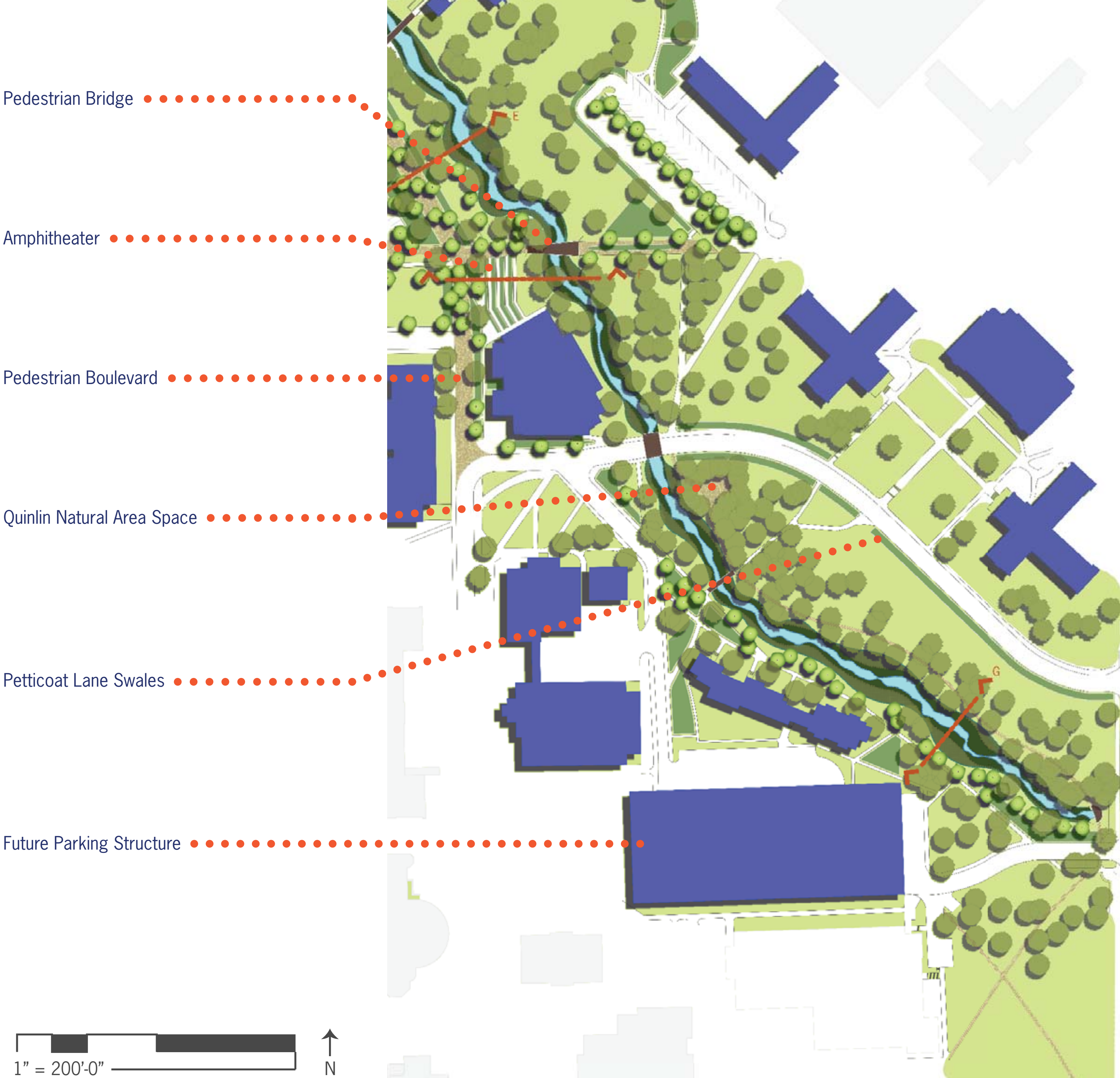
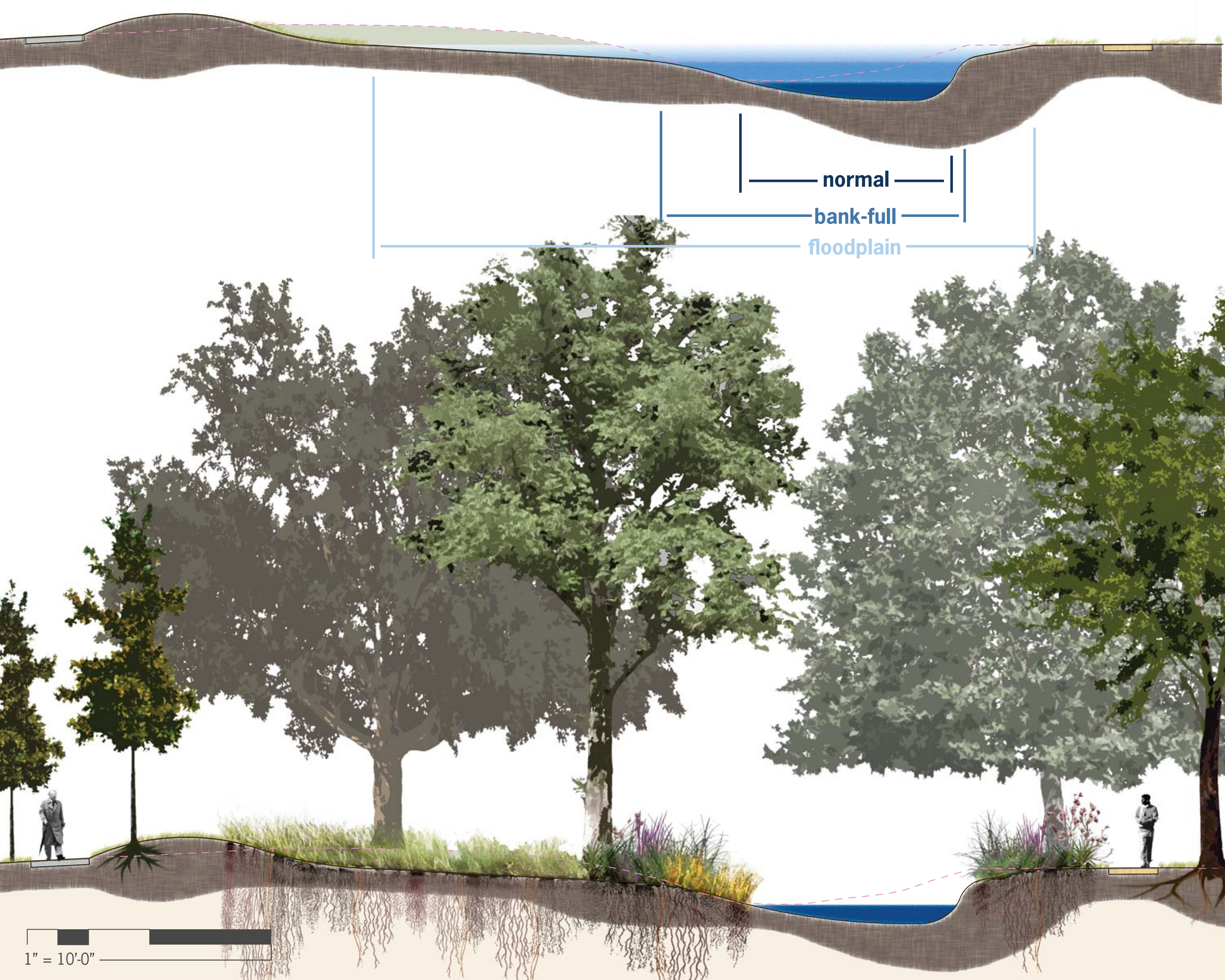


Figure 47 - Campus Creek South Plan (Meihaus 2009)

Figure 48 (top) - Section G: Typical "B" Channel, and Floodplain Function (Meihaus 2009)

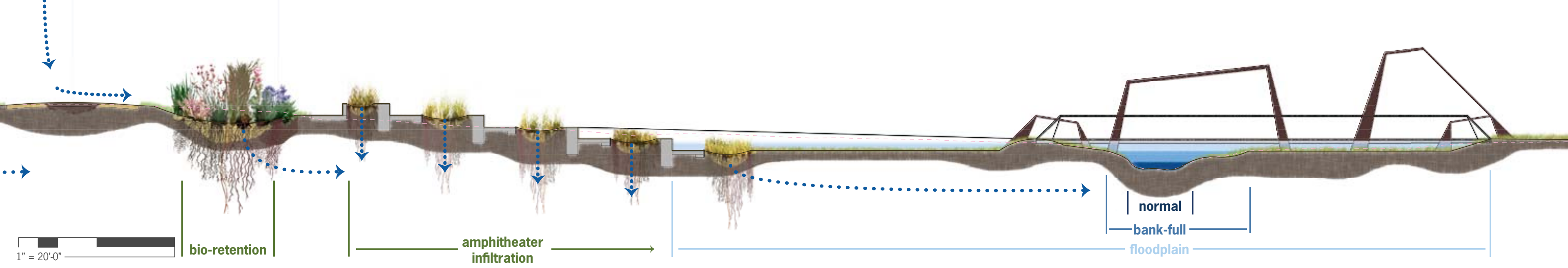
Figure 49 (bottom) - Section G: South Reach "B" Channel and Floodplain Illustration (Meihaus 2009)


normal
bank-full
floodplain
1” = 10’-0”

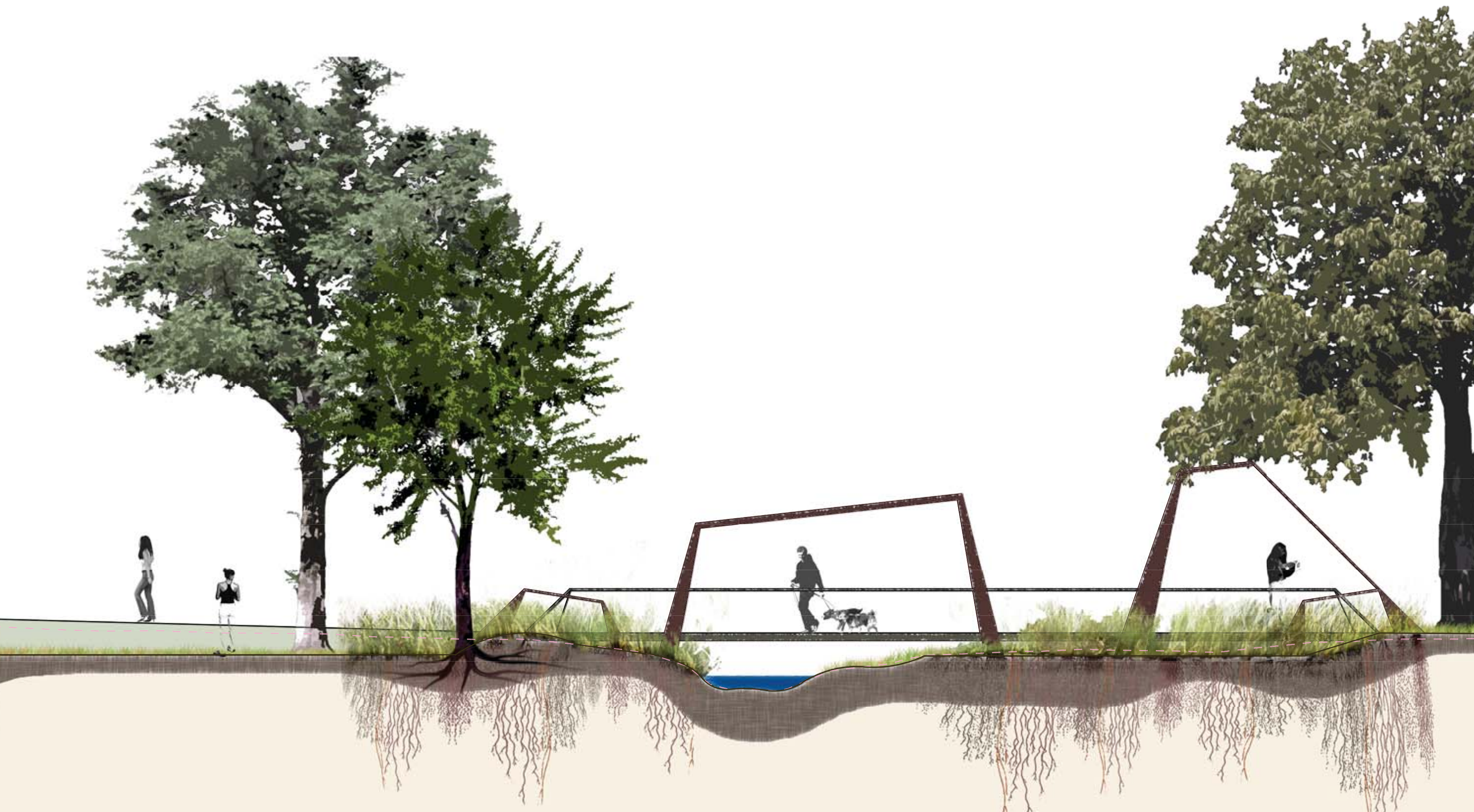
Campus Creek South

Figure 50 (right) - Section F: South Reach “B” Channel, Floodplain, Amphitheater, and Bridge Design (Meihaus 2009)

Figure 51 (bottom) - Section F: BMP Amphitheater Alternative (Meihaus 2009)



1" = 20'-0"
bio-retention
amphitheater infiltration
normal
bank-full
floodplain



Conclusion

This masters project and report serves to communicate an ideal in the form of a conceptual landscape architecture planning and design effort. The ideal is urban equilibrium; discovering balance between the needs of properly functioning hydrologic, social, and aesthetic site conditions. The medium for expressing this ideal is a Comprehensive Plan for improvement of Kansas State University's Campus Creek corridor. The plan takes a wholistic approach to the assessment, programming, planning, and the design of Campus Creek. The final proposal is a conceptual representation of what the future could hold for the creek and its relationship with the campus.

The final concept was developed over time following adapted methodologies for sub-watershed assessment, storm-water run-off quantification, and qualitative characterization. The resulting proposal illustrates a program for enhancement determined by the need to discover a balance of achievable goals and objectives previously outlined.

Hydrologic goals objectives illustrated within this proposal include planning and design which prioritizes the need for a naturally stable channel plan, profile, and cross-sectional dimensions for campus creek. The plan addresses different levels of urban sub-watershed improvement strategies including storm-water bio-retention, volume run-off detention, and significant improvement of a naturally functioning riparian floodplain. The intentions for manipulation of both the campus and the creek address both long-term planning improvements and illustrations of site design concepts.

Future efforts to improve campus creek should consider the long term health and integrity of the entire sub-watershed. Reference reaches, stream gauge data, precise channel measurements, detailed bank-stability evaluation, and more accurate methods and models for quantifying storm-water run-off within the sub-watershed will be required for a successful implementation of proper restoration techniques on Campus Creek.

Aside from direct efforts to enhance the channel or the floodplain, environmentally sensitive land use management respecting a substantial buffer zone around the creek will be necessary to conserve the existing remains of a channel and floodplain. Without a change in development trends and in the perception of the creek as an indispensable and natural amenity for the future of the university, Campus Creek will continue to lose any prominence or physical presence. The sub-watershed extends beyond an identifiable channel in many places, some beyond the boundaries of K-State, but further understanding of all the urban impacts on the creek are necessary for a wholistic and successful approach to enhancing Campus Creek as a place worth caring about.

Just as the Creek should not be a second-hand landscape to the campus, neither should the social campus environment lie at the mercy of uninhibited sub-watershed and channel improvement. A functional campus in terms of circulation, access, formal and spatial amenities carry equal weight in a successful proposal. The corridor serves as a naturally organizing element for future development of the campus, and for redevelopment where the creek has already been forgotten.

Appendix A:

90 Additional Assessment Mapping

90 Catchment 9
96 Catchment 8
102 Catchment 7
108 Catchment 6
114 Catchment 5
120 Catchment 4

Additional Assessment Mapping

Catchment 9

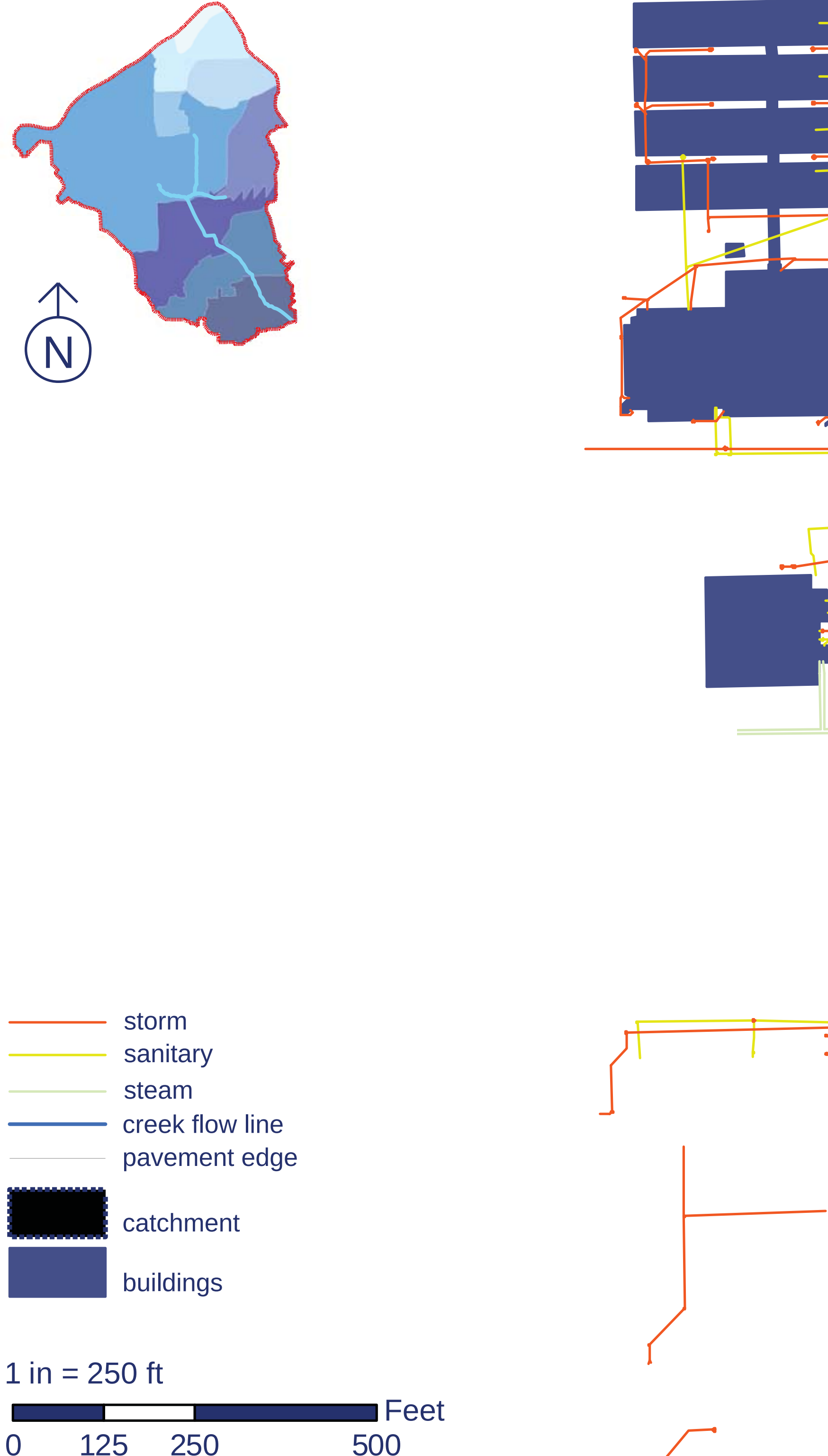
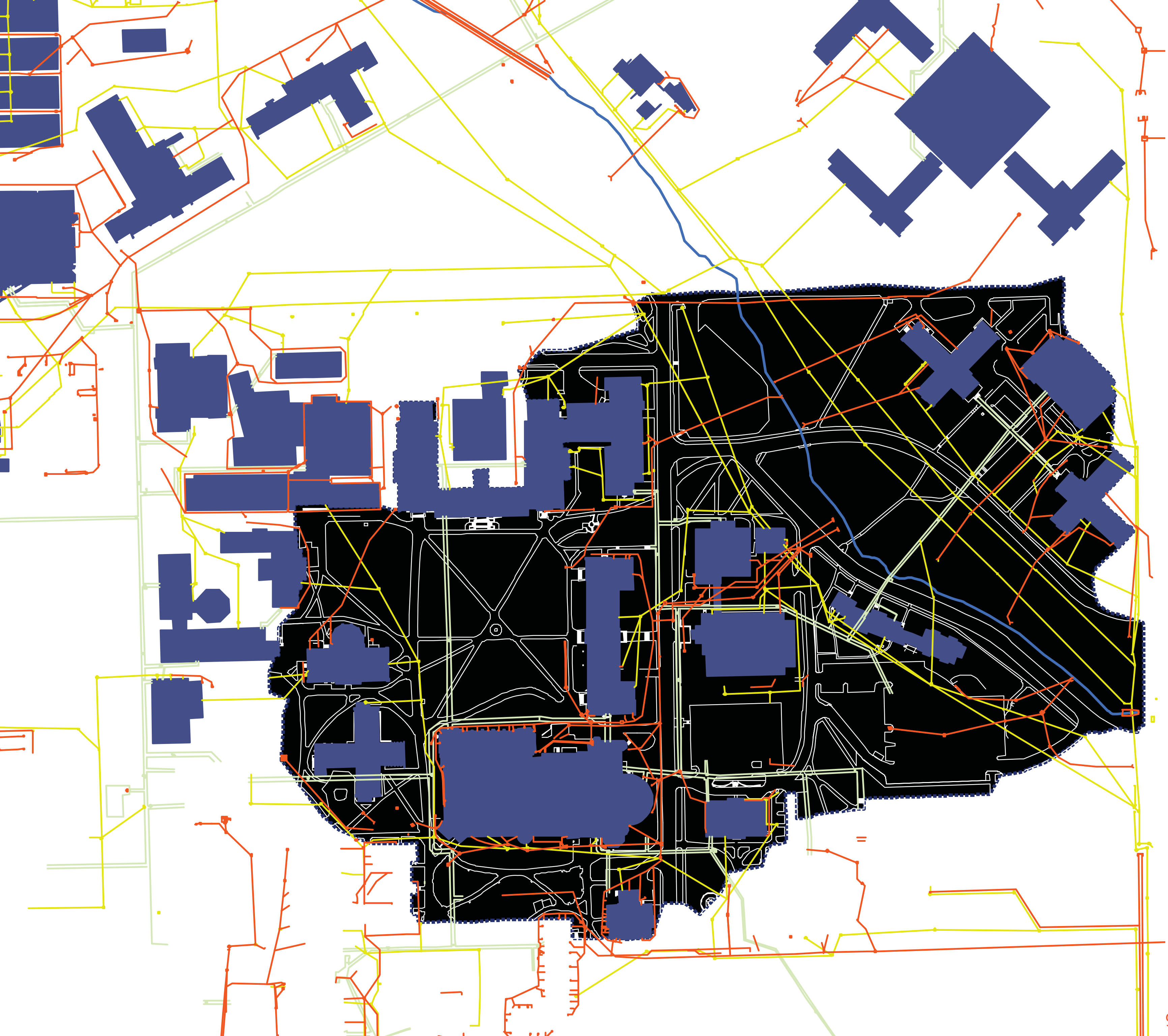


Figure A1 - Catchment 9 Utilities and Infrastructure (Meihaus 2008)



Additional Assessment Mapping

Catchment 9

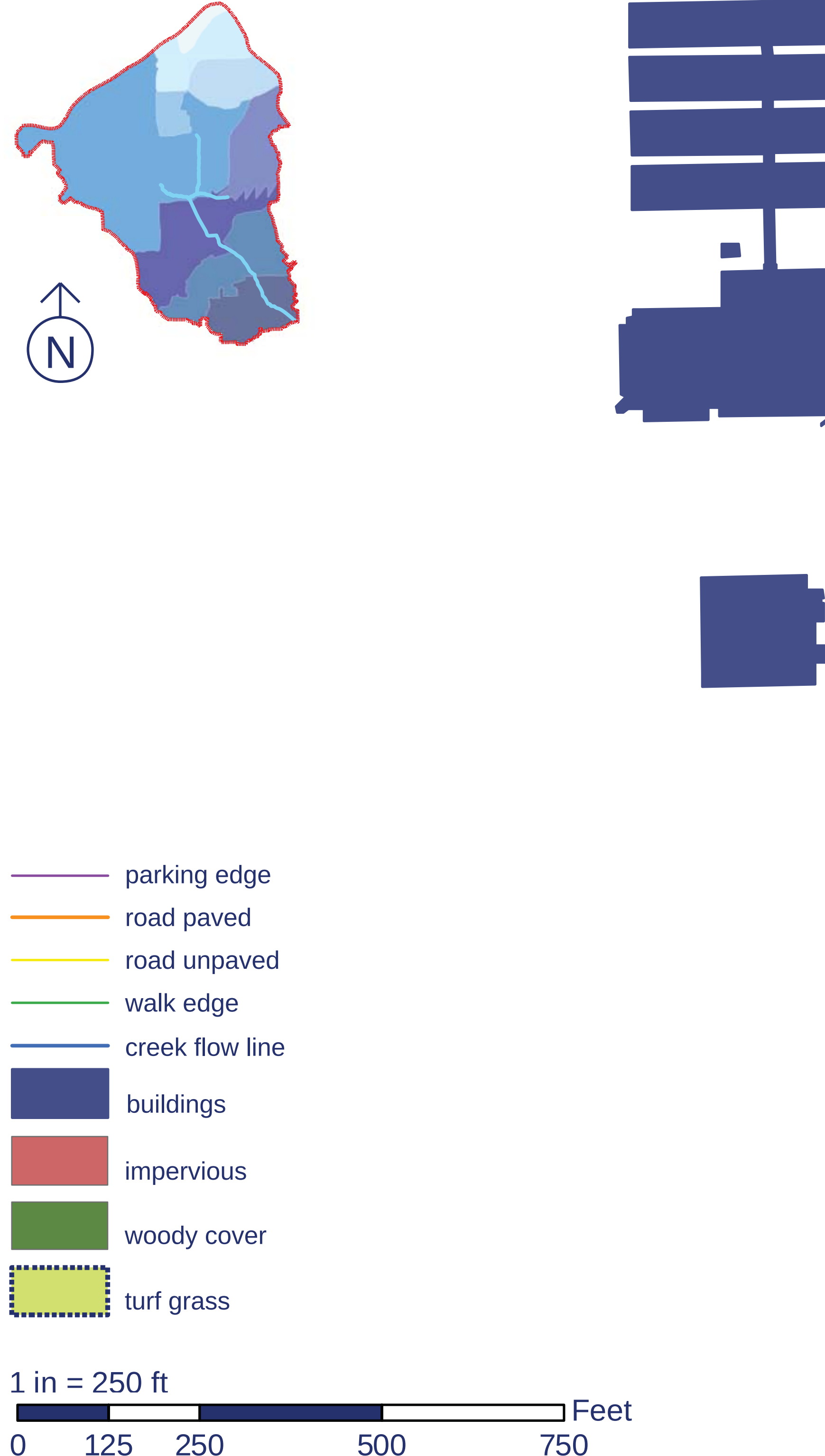


Figure A2 - Catchment 9 Surface Types (Meihaus 2008)

Catchment 9

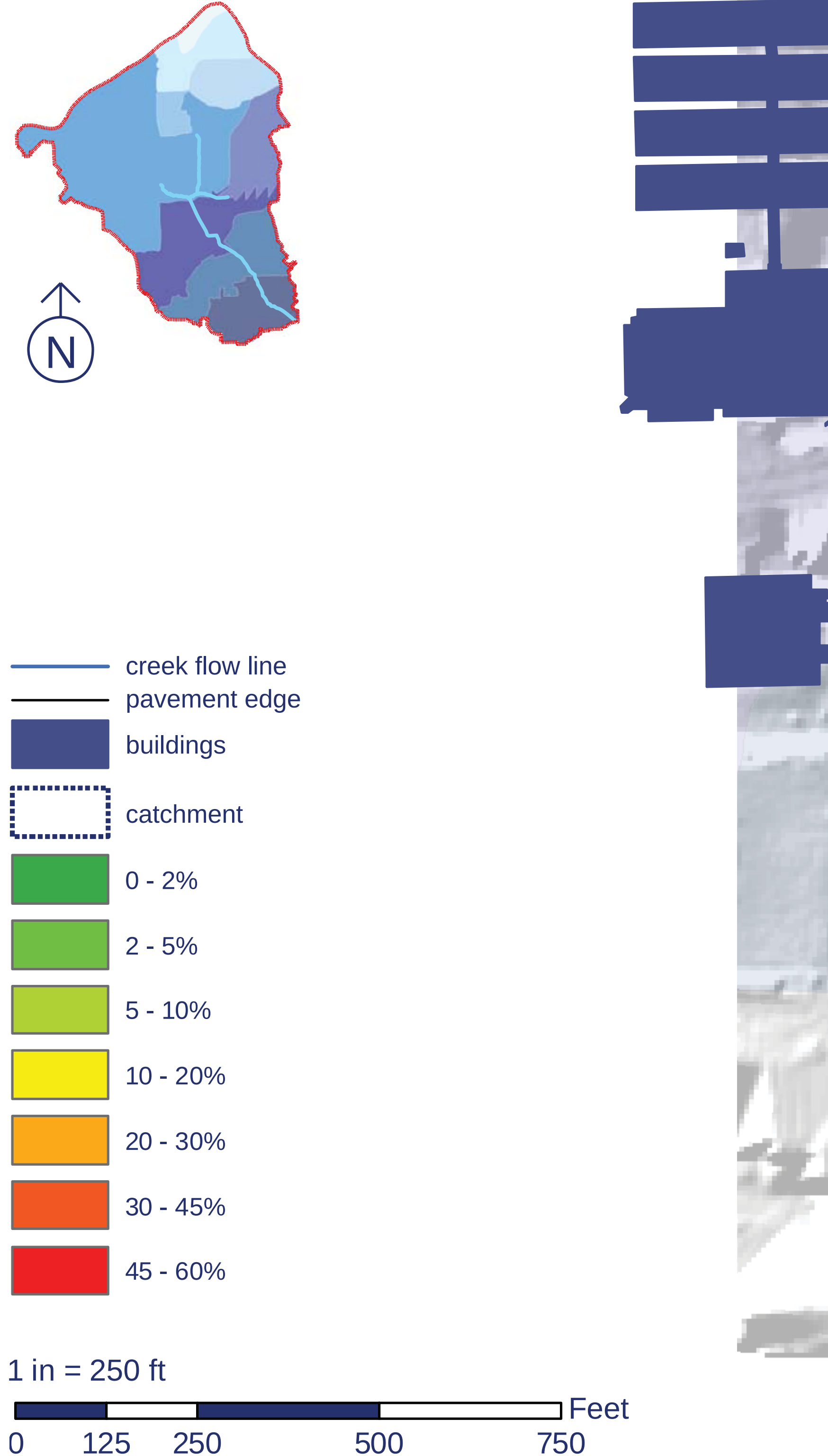
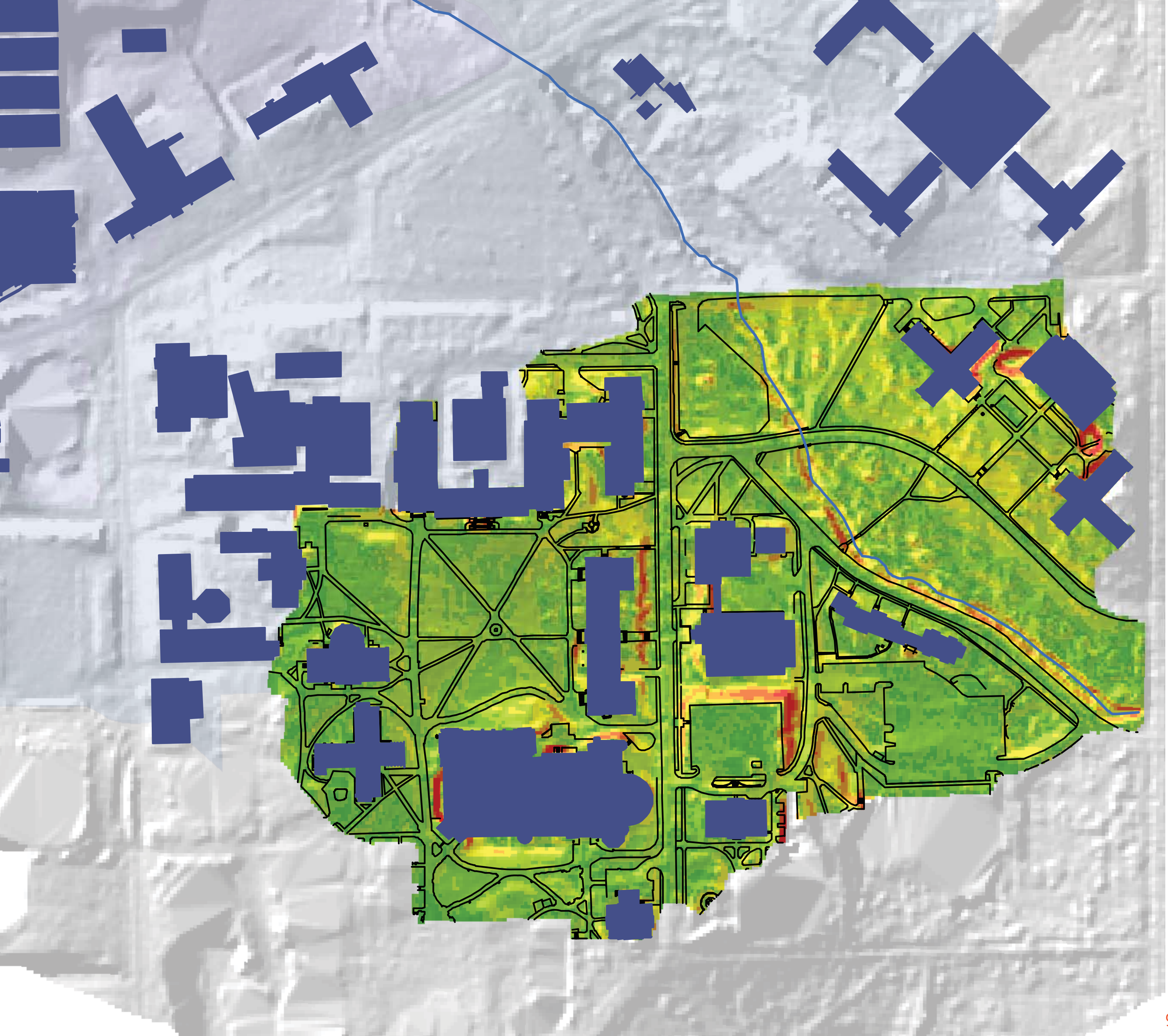


Figure A3 - Catchment 9 Slope Percentage and Hillshade (Meihaus 2008)



Additional Assessment Mapping

Catchment 8

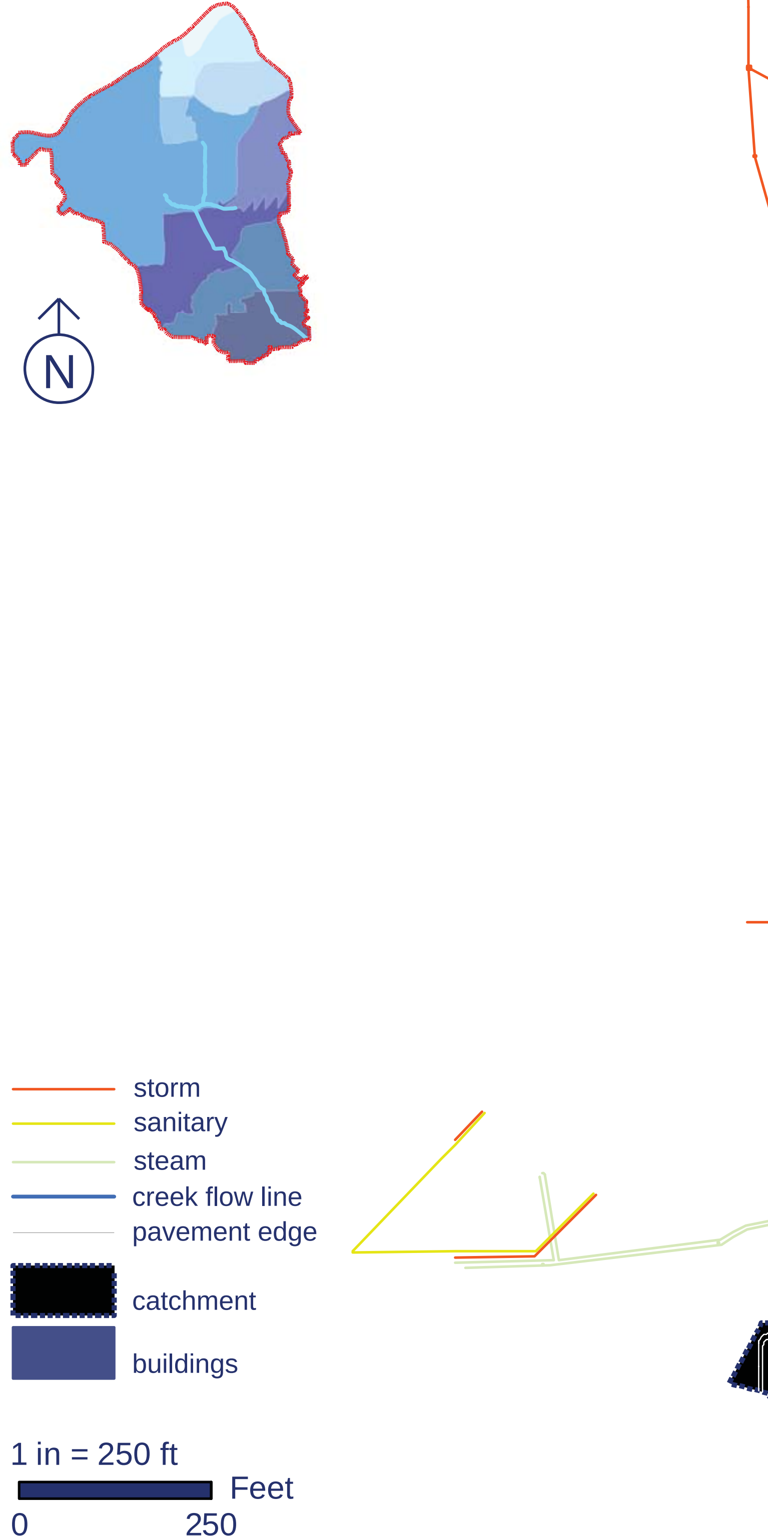
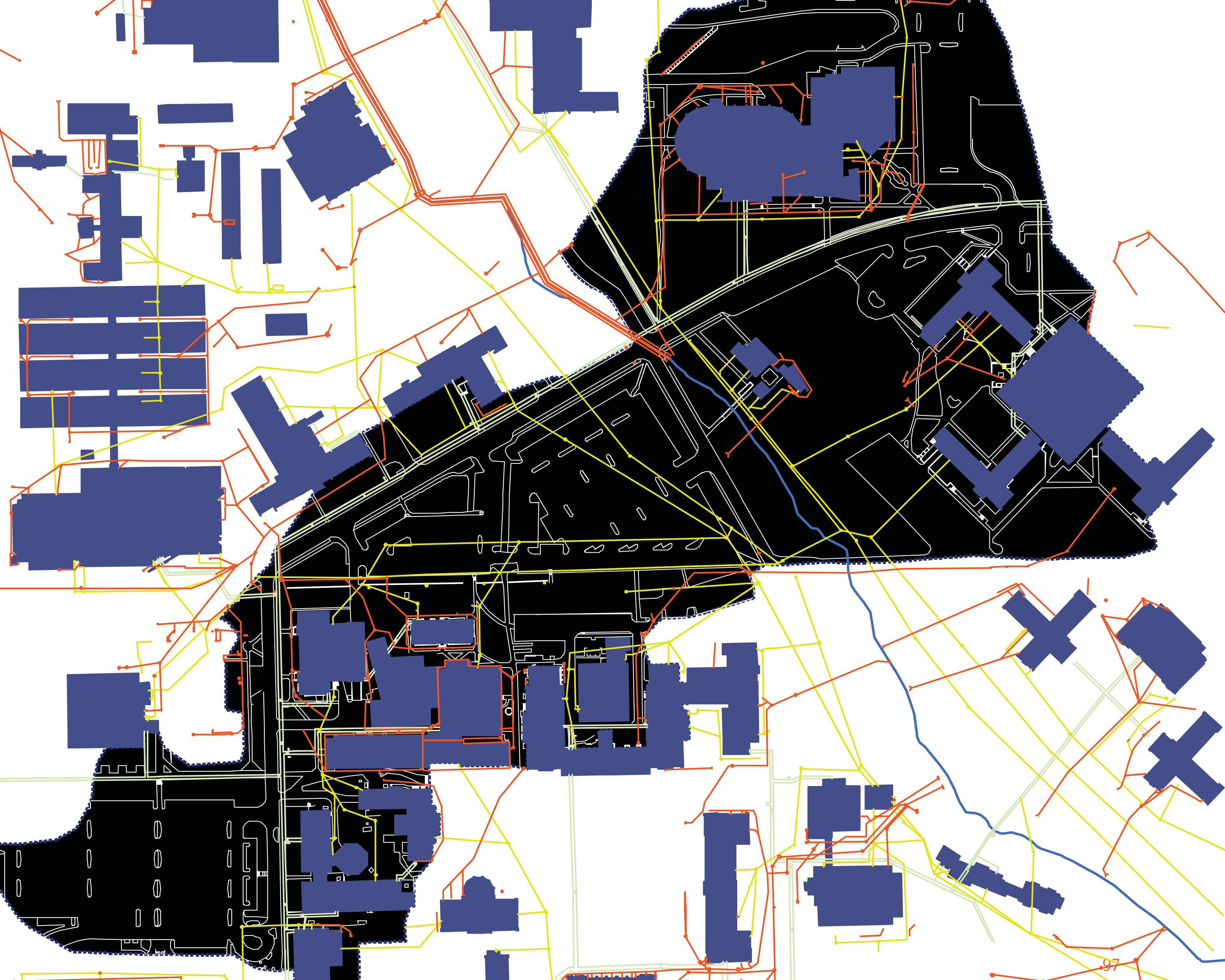


Figure A4 - Catchment 8 Utilities and Infrastructure (Meihaus 2008)



Additional Assessment Mapping

Catchment 8

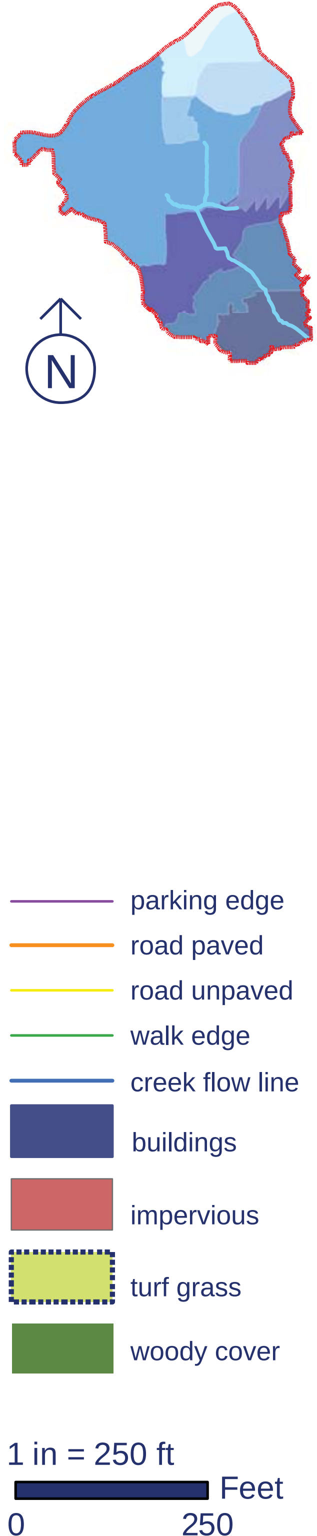


Figure A5 - Catchment 8 Surface Types (Meihaus 2008)

Additional Assessment Mapping

Catchment 8

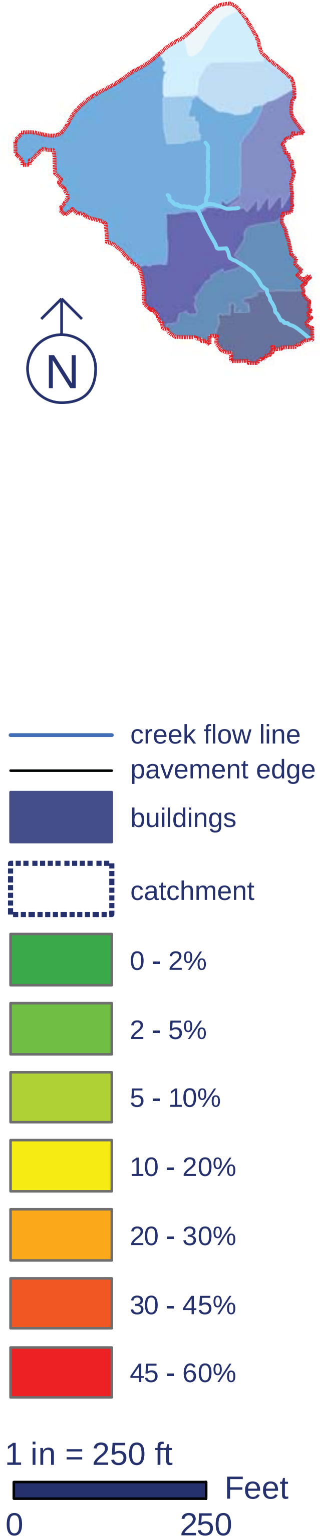


Figure A6 - Catchment 8 Slope Percentage and Hillshade (Meihaus 2008)

Additional Assessment Mapping

Catchment 7

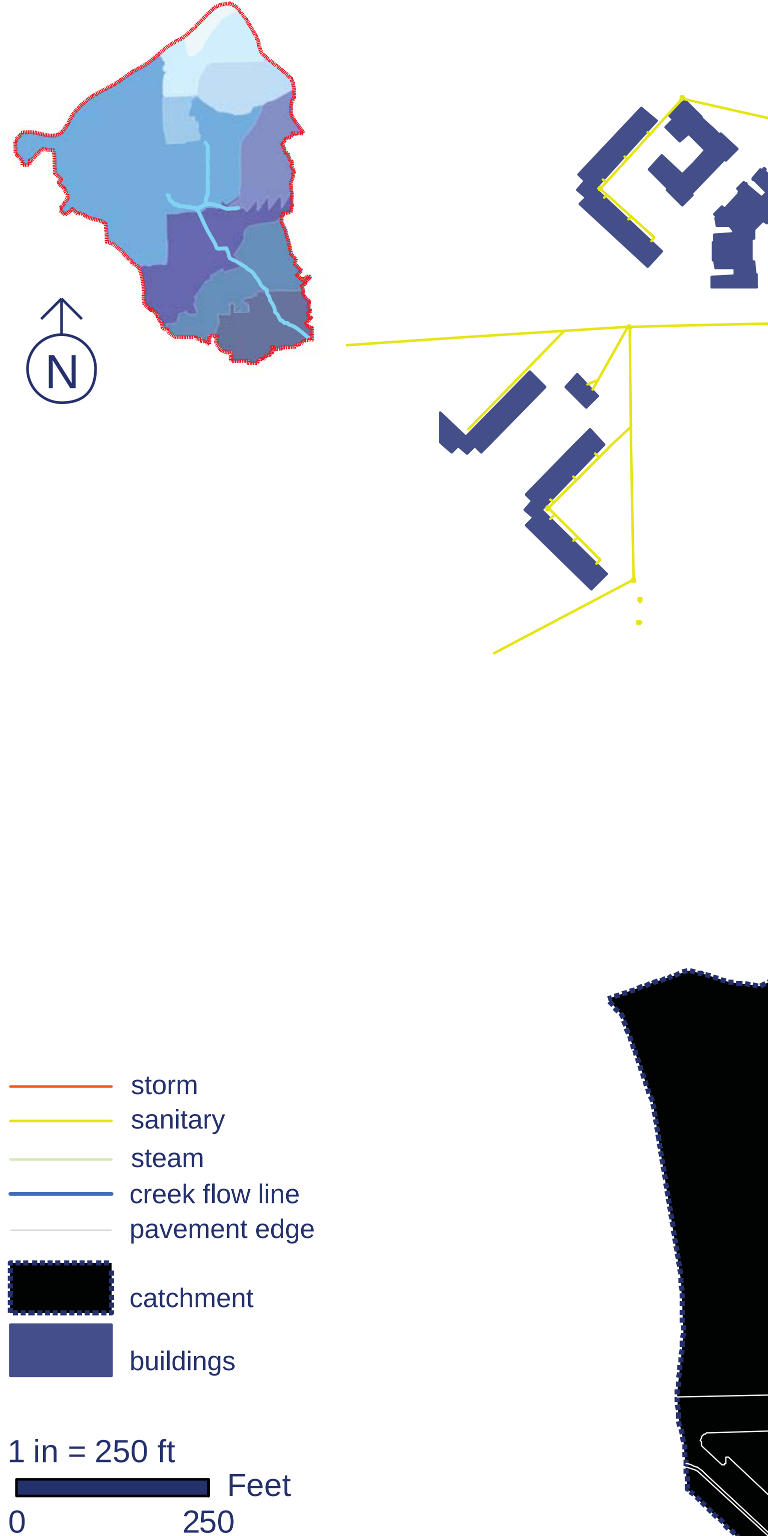


Figure A7 - Catchment 7 Utilities and Infrastructure (Meihaus 2008)

Additional Assessment Mapping

Catchment 7

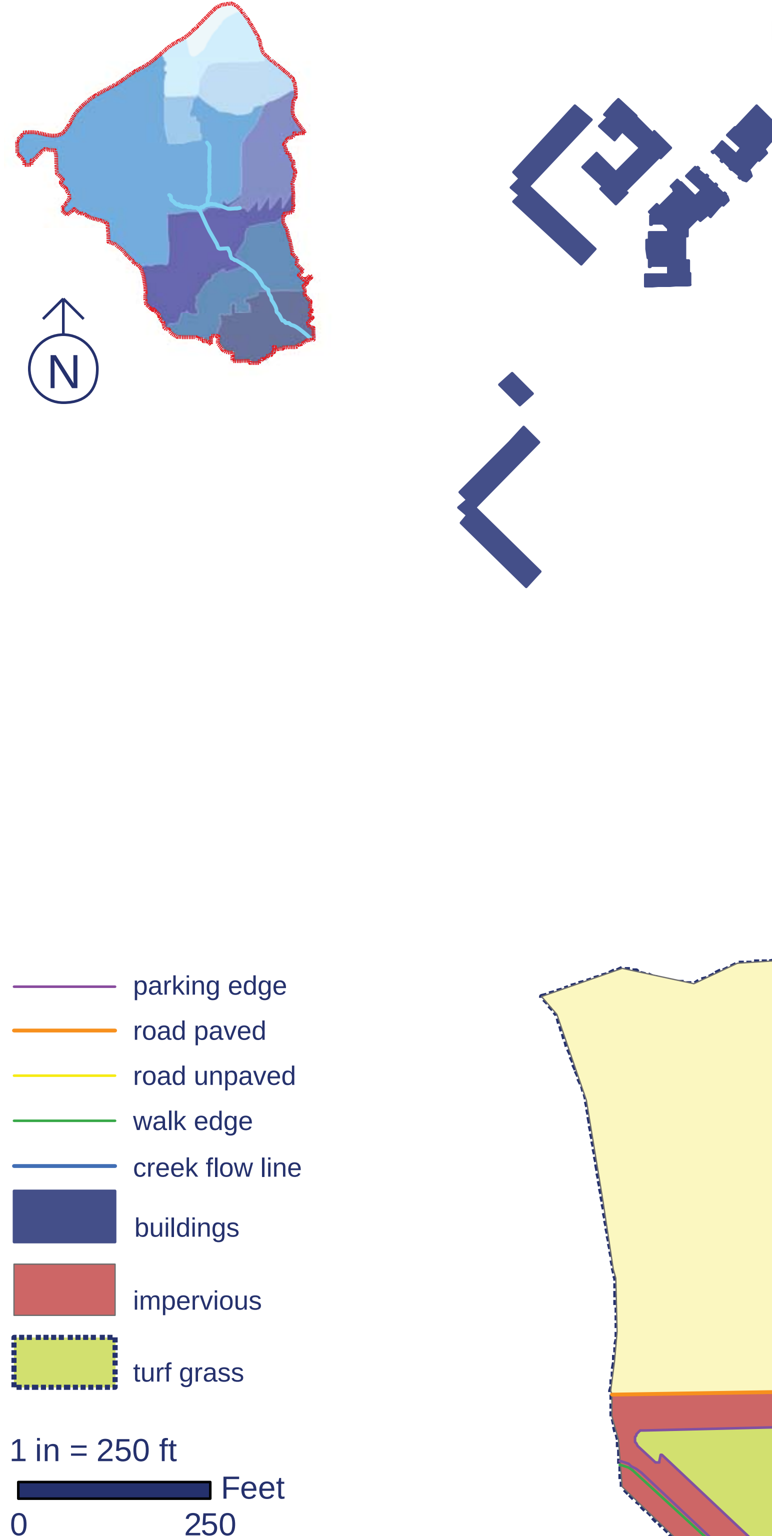
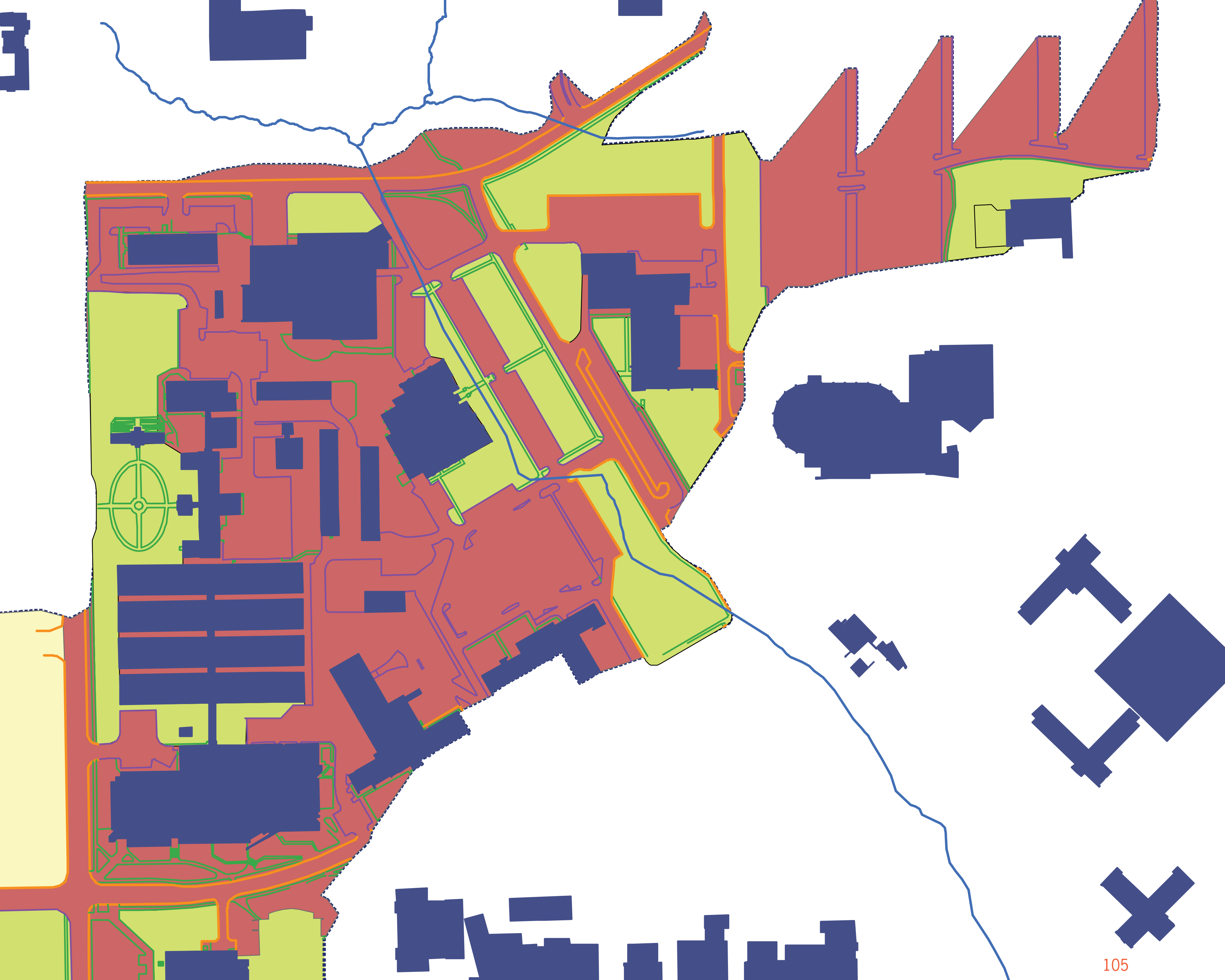


Figure A8 - Catchment 7 Surface Types (Meihaus 2008)



Additional Assessment Mapping

Catchment 7

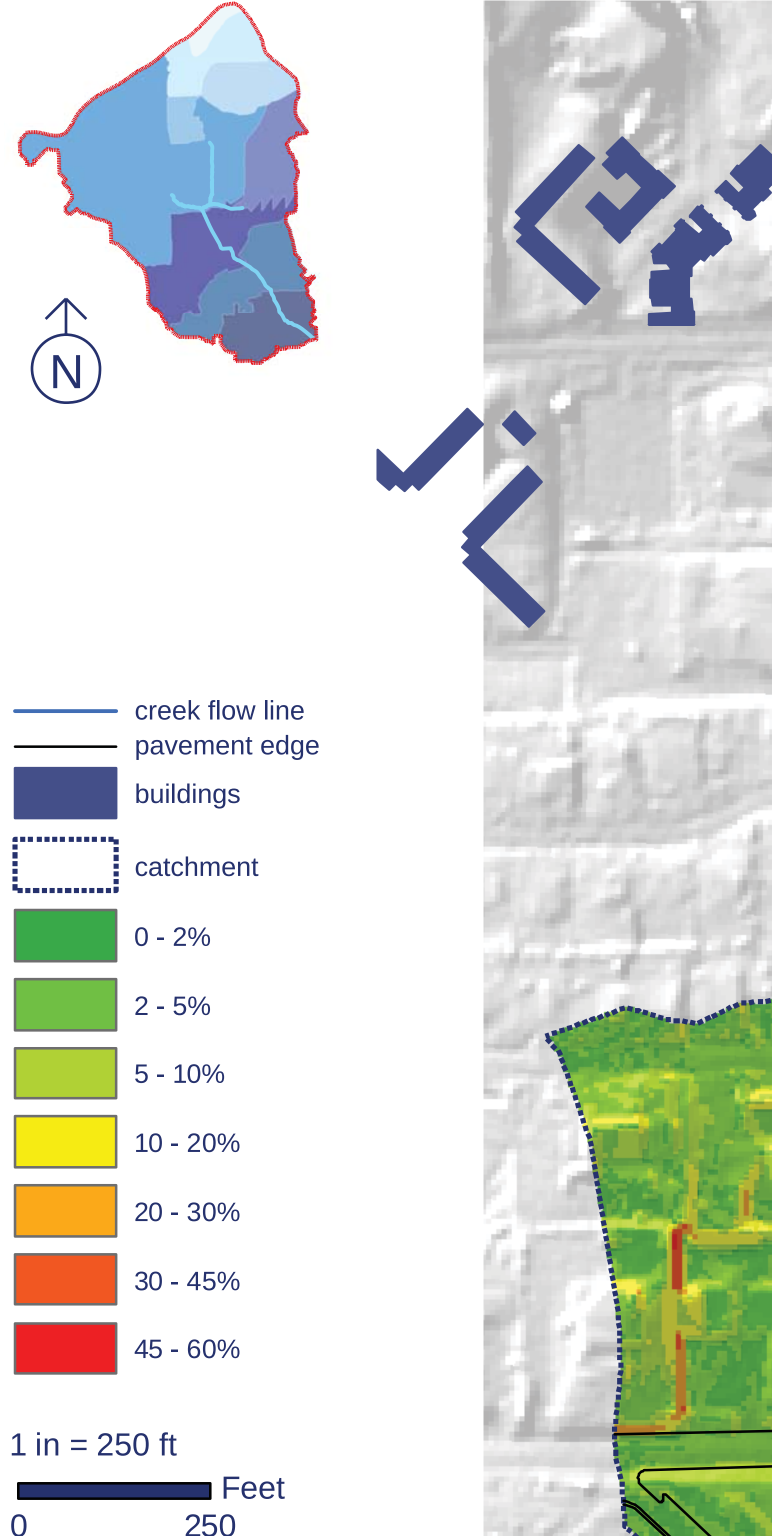


Figure A9 - Catchment 7 Slope Percentage and Hillshade (Meihaus 2008)

Additional Assessment Mapping

Catchment 6

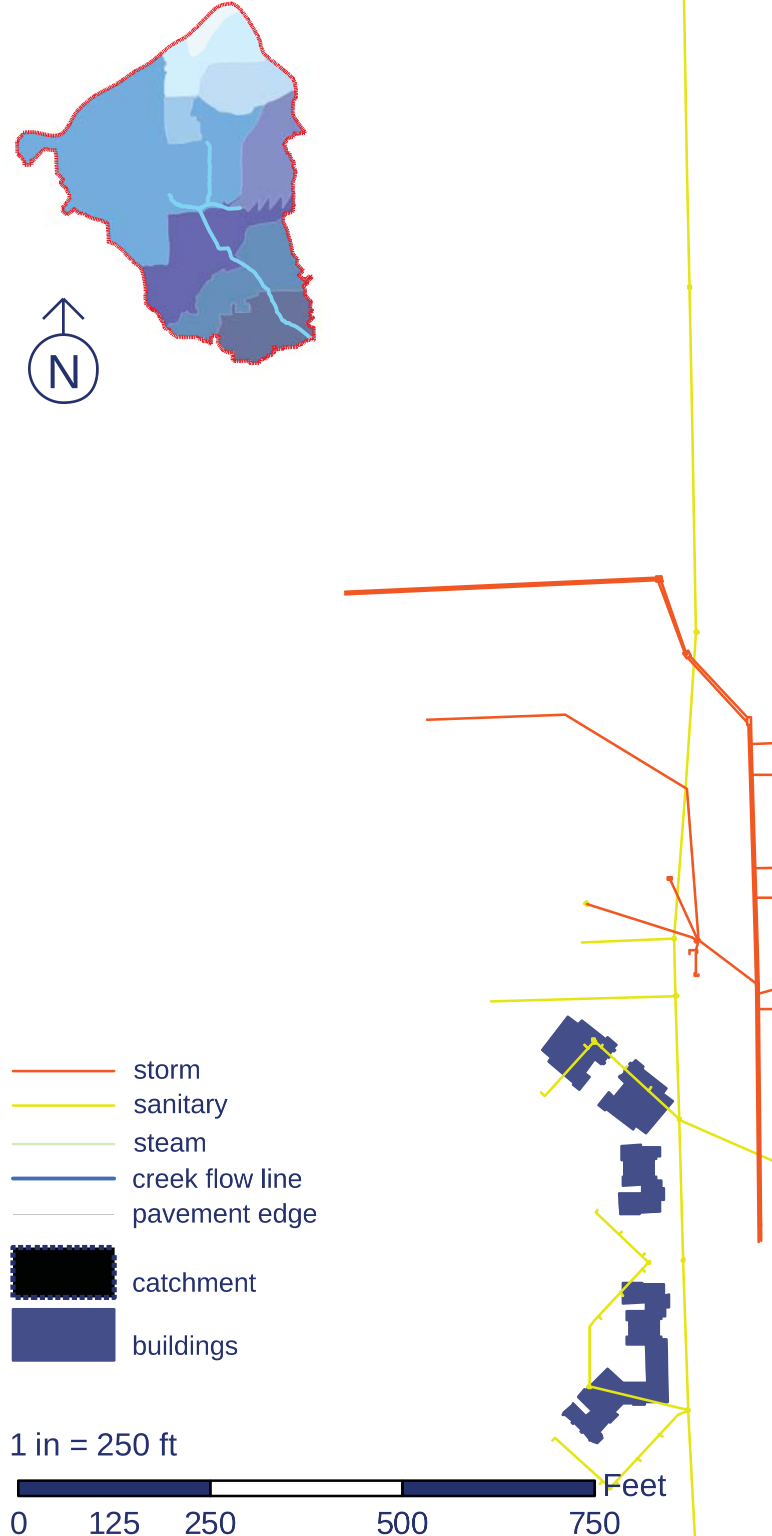
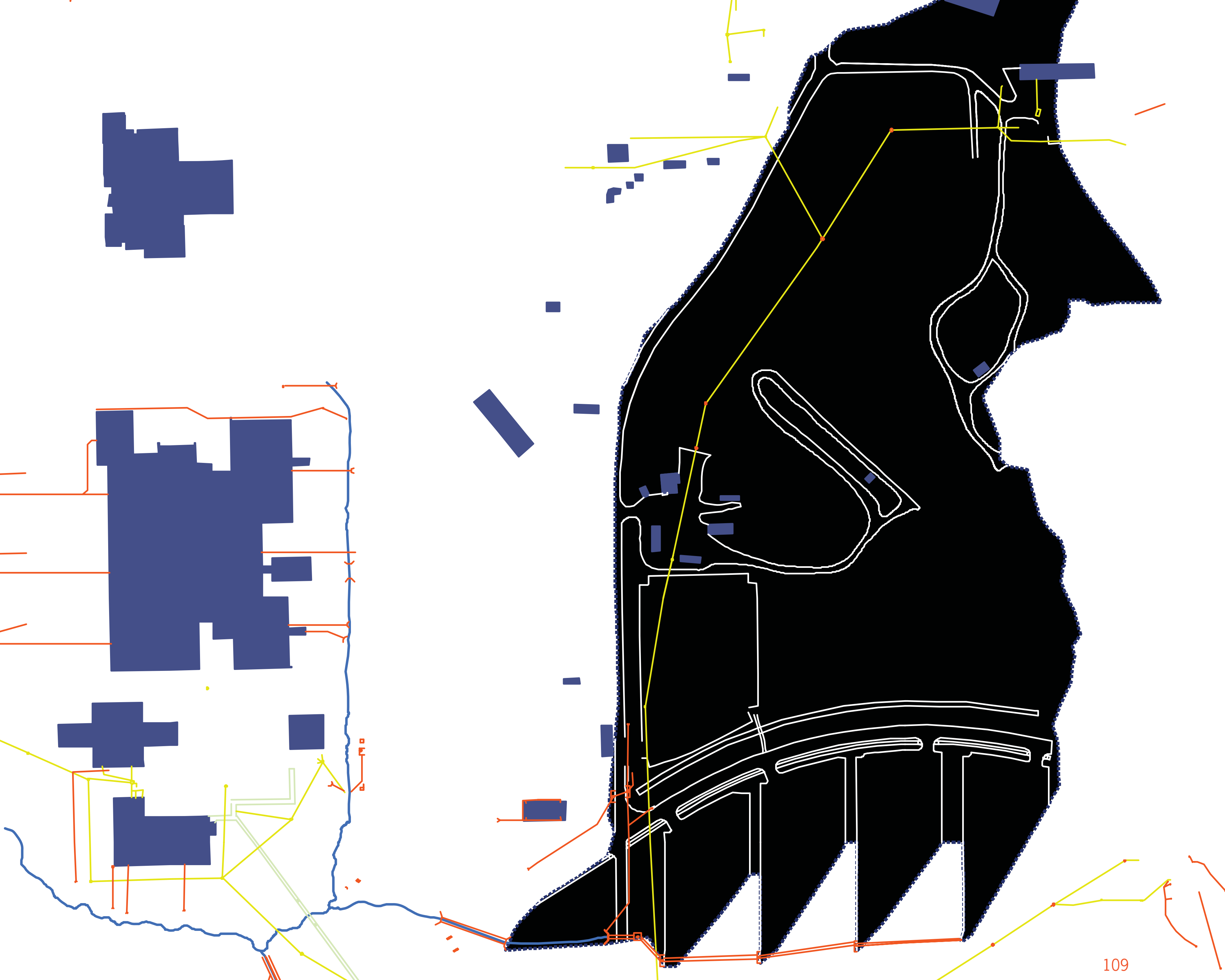


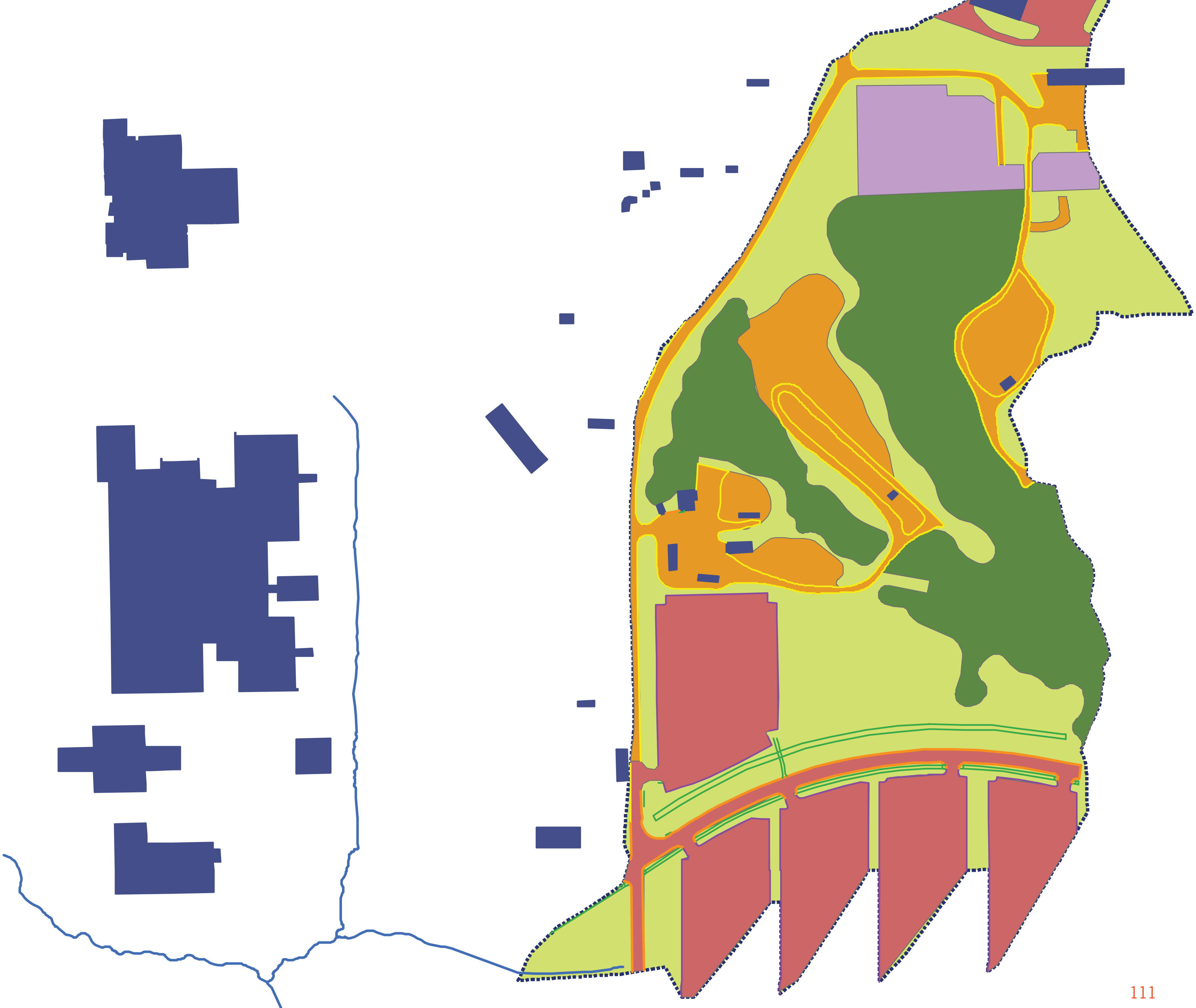
Figure A10 - Catchment 6 Utilities and Infrastructure (Meihaus 2008)



Additional Assessment Mapping

Catchment 6

Figure A11 - Catchment 6 Surface Types (Meihaus 2008)



Catchment 6

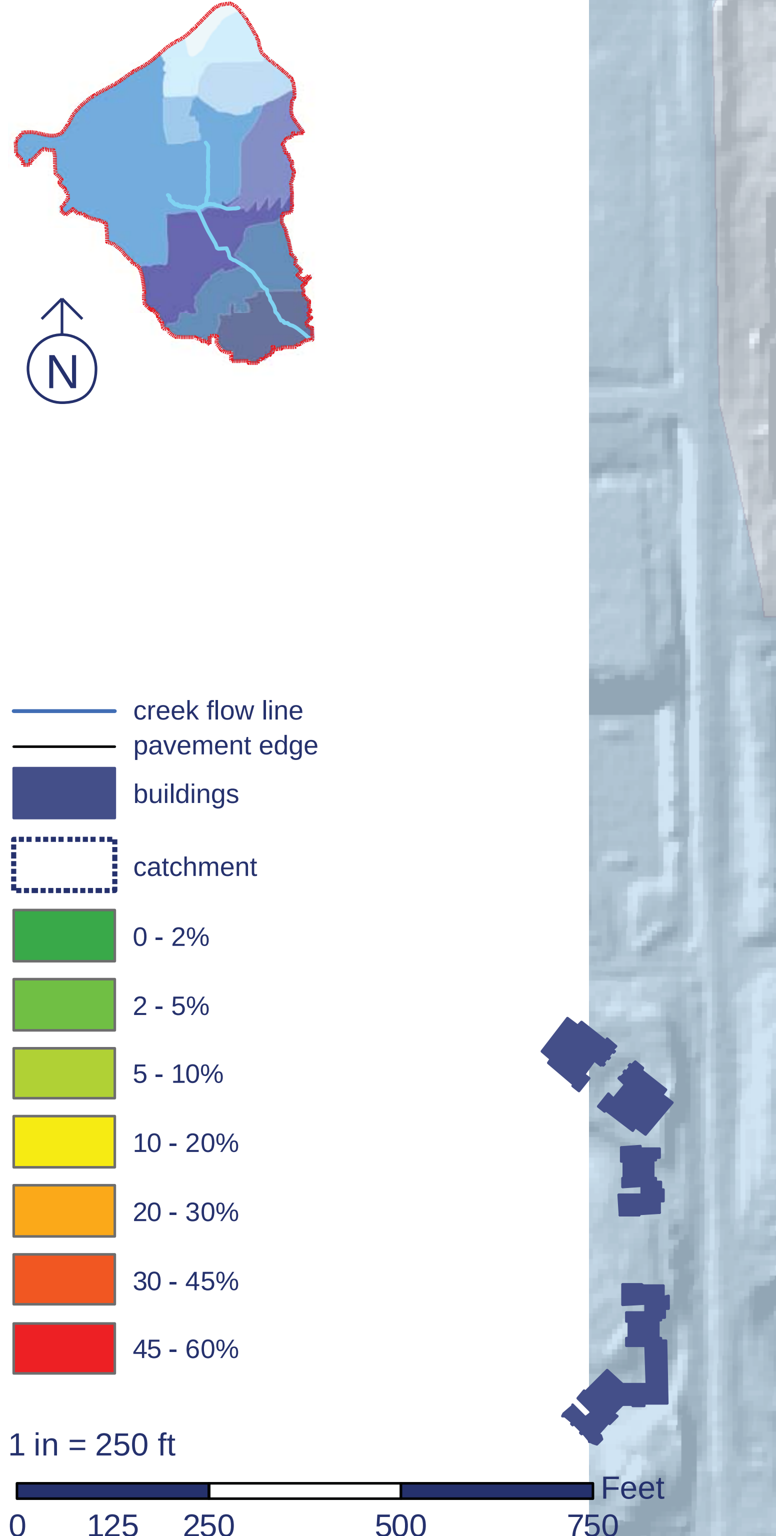
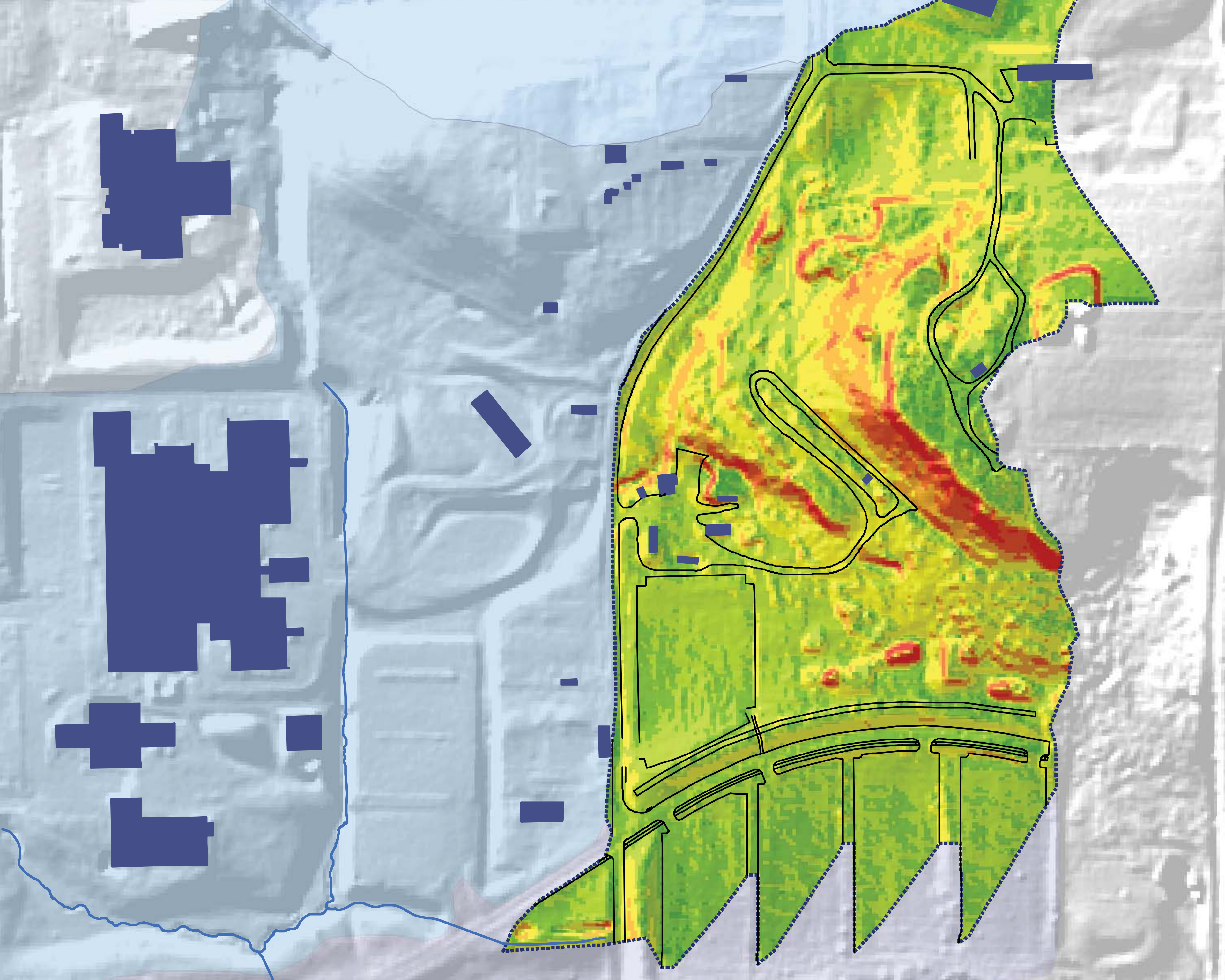


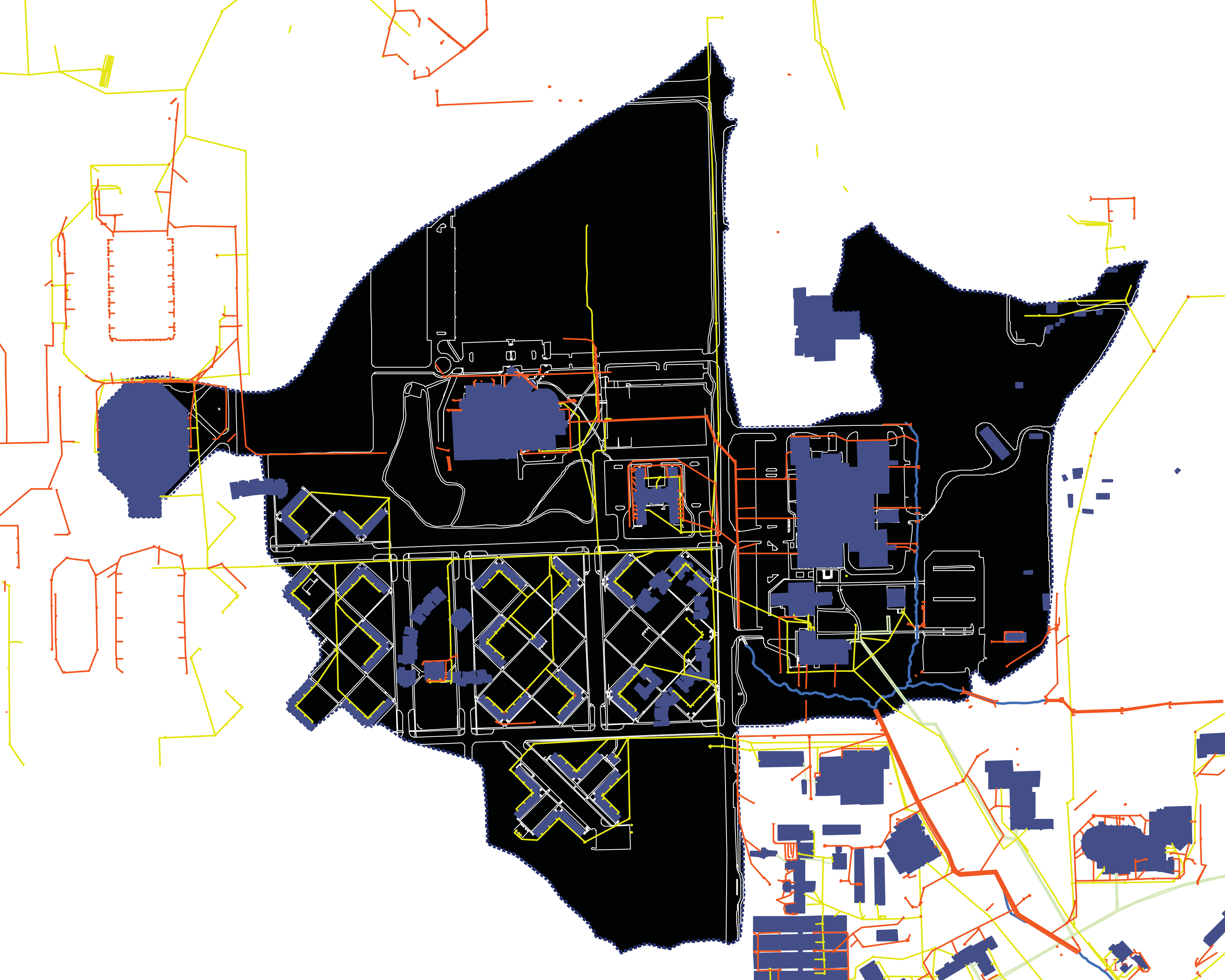
Figure A12 - Catchment 6 Slope Percentage and Hillshade (Meihaus 2008)



Additional Assessment Mapping

Catchment 5

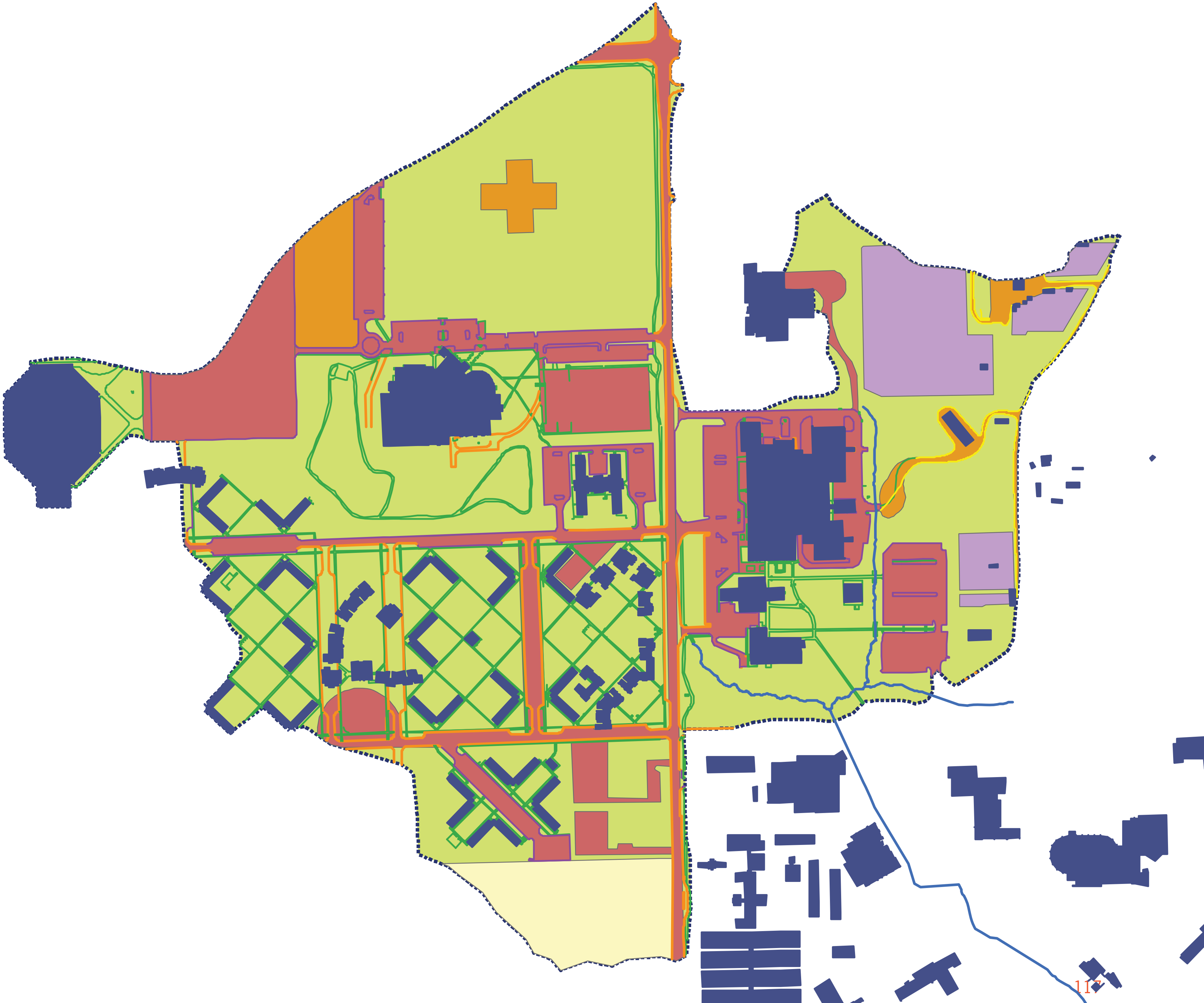
Figure A13 - Catchment 5 Utilities and Infrastructure (Meihaus 2008)



Additional Assessment Mapping

Catchment 5

Figure A14 - Catchment 5 Surface Types (Meihaus 2008)



Additional Assessment Mapping

Catchment 5

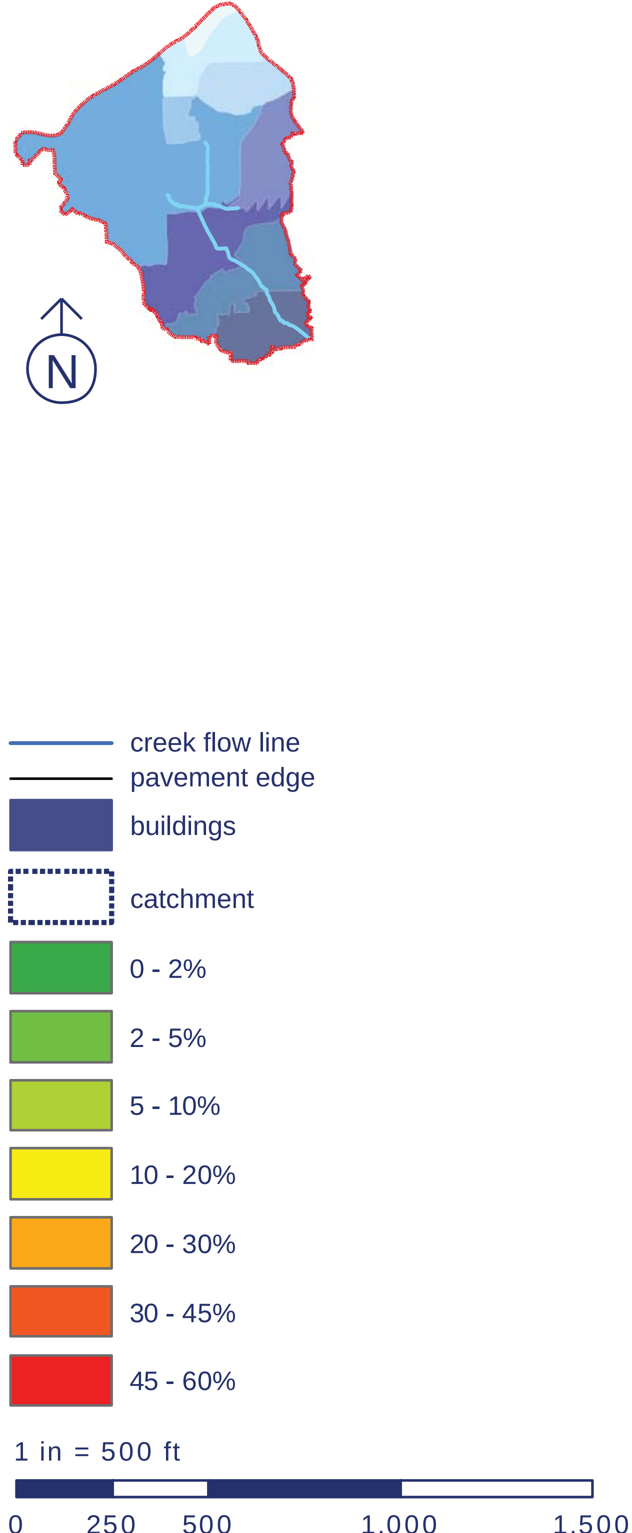


Figure A15 - Catchment 5 Slope Percentage and Hillshade (Meihaus 2008)

Catchment 4

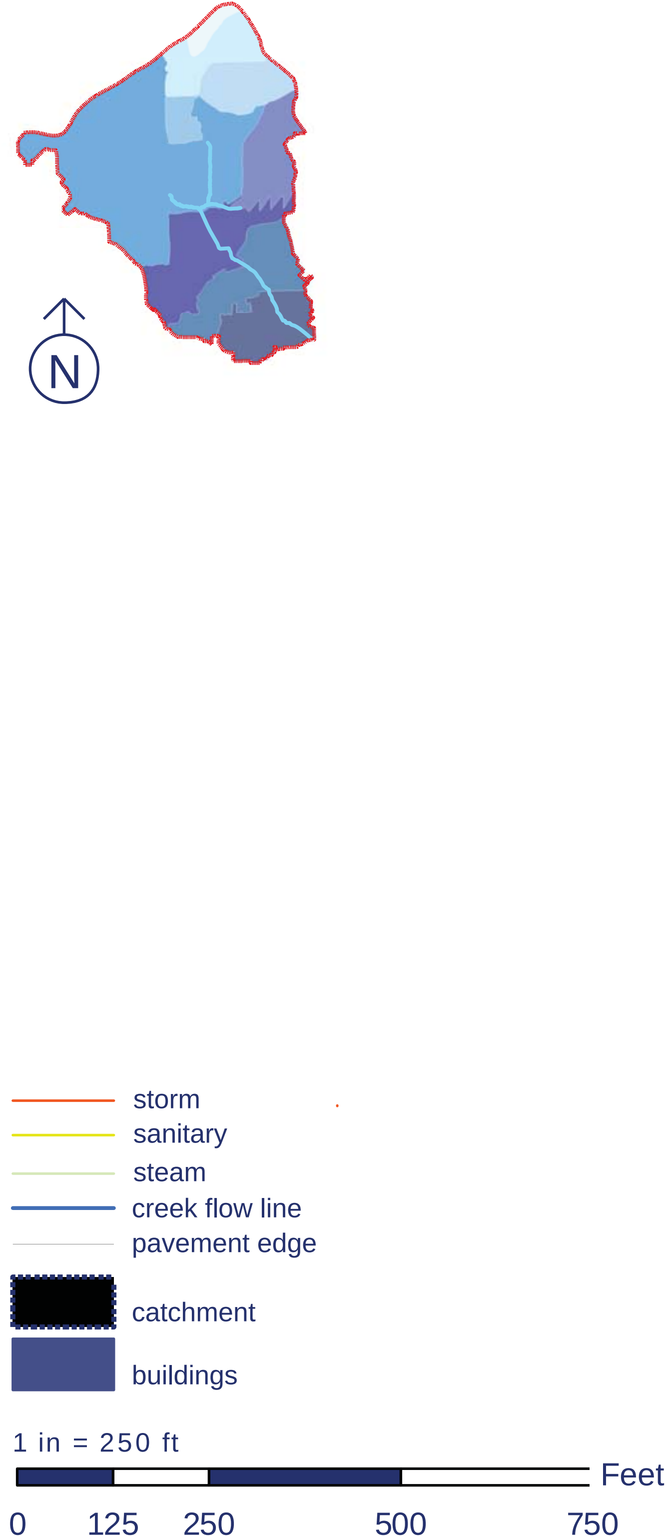
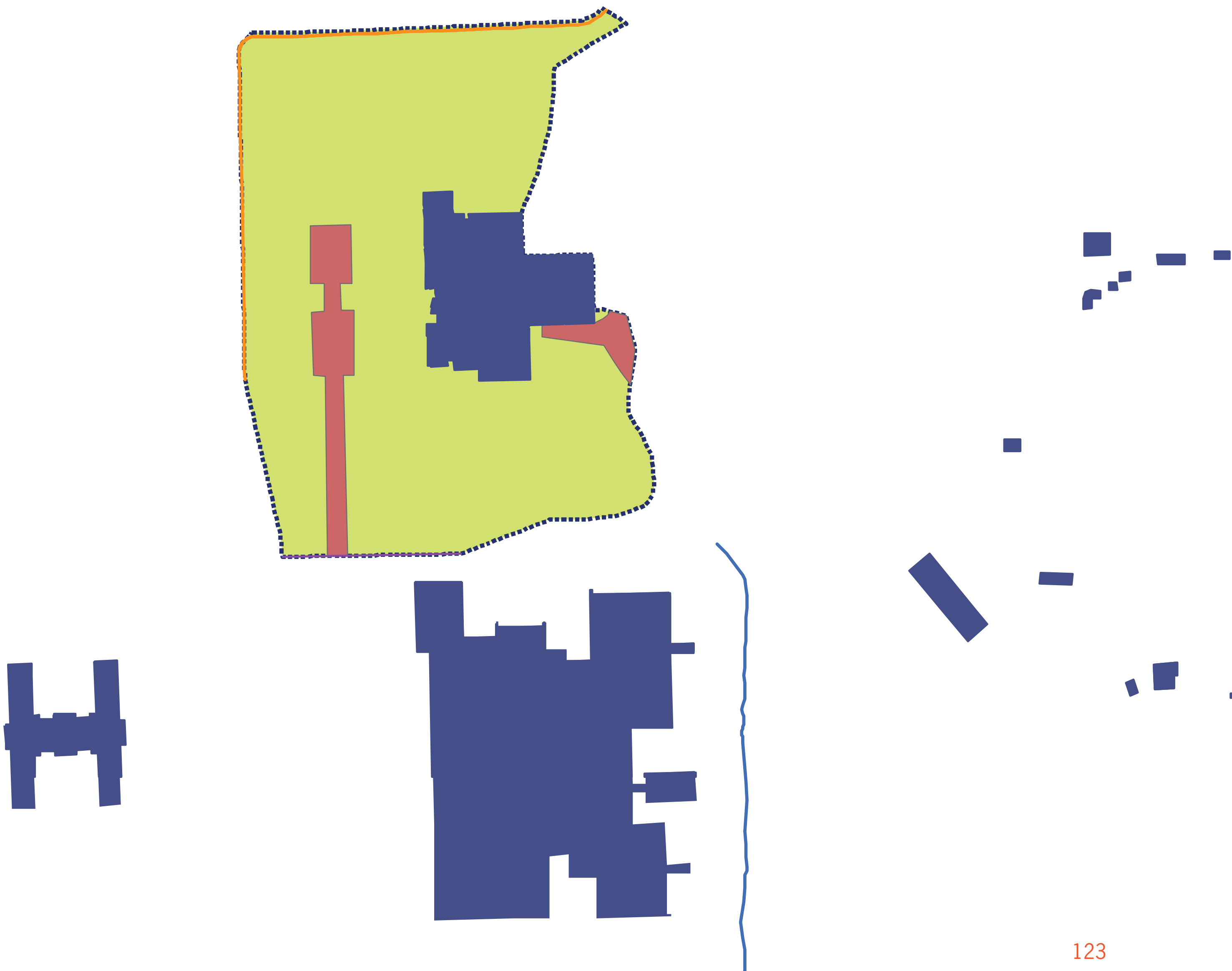


Figure A16 - Catchment 4 Utilities and Infrastructure (Meihaus 2008)

Additional Assessment Mapping

Catchment 4

Figure A17 - Catchment 4 Surface Types (Meihaus 2008)



Catchment 4

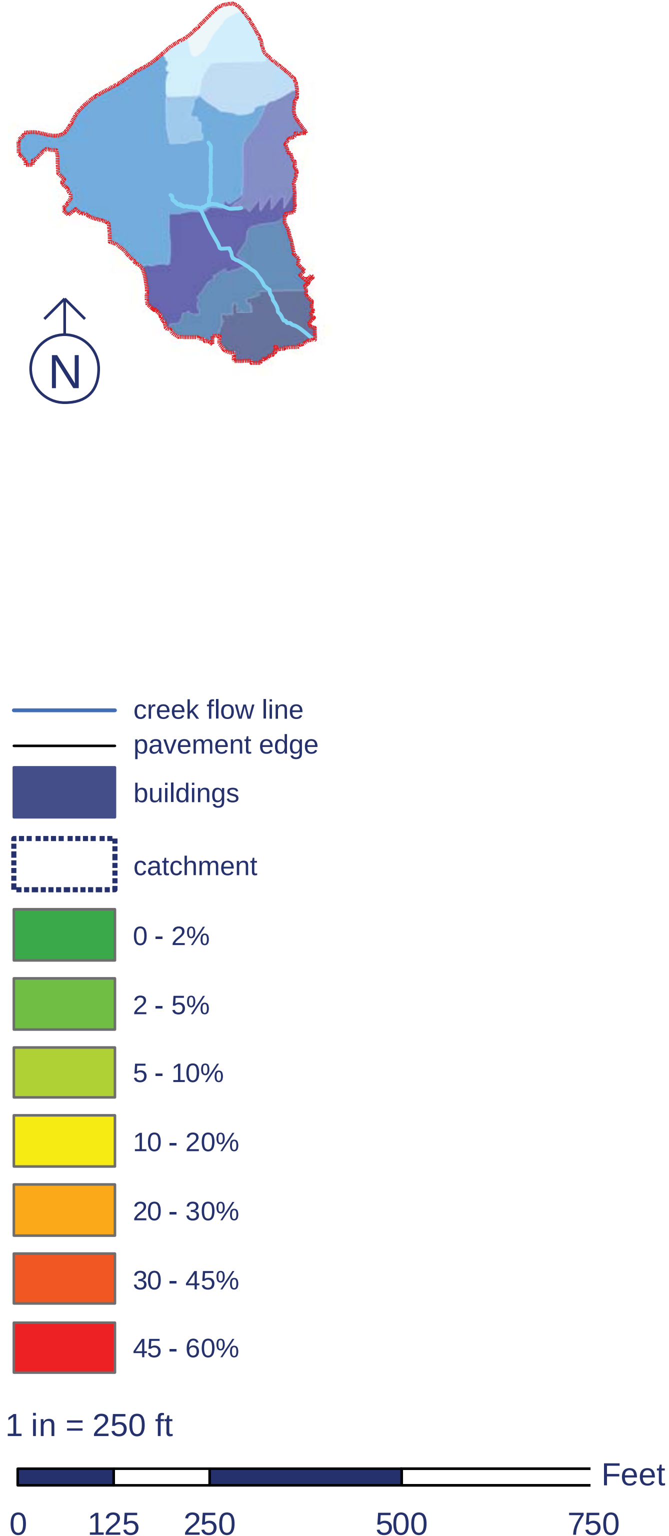
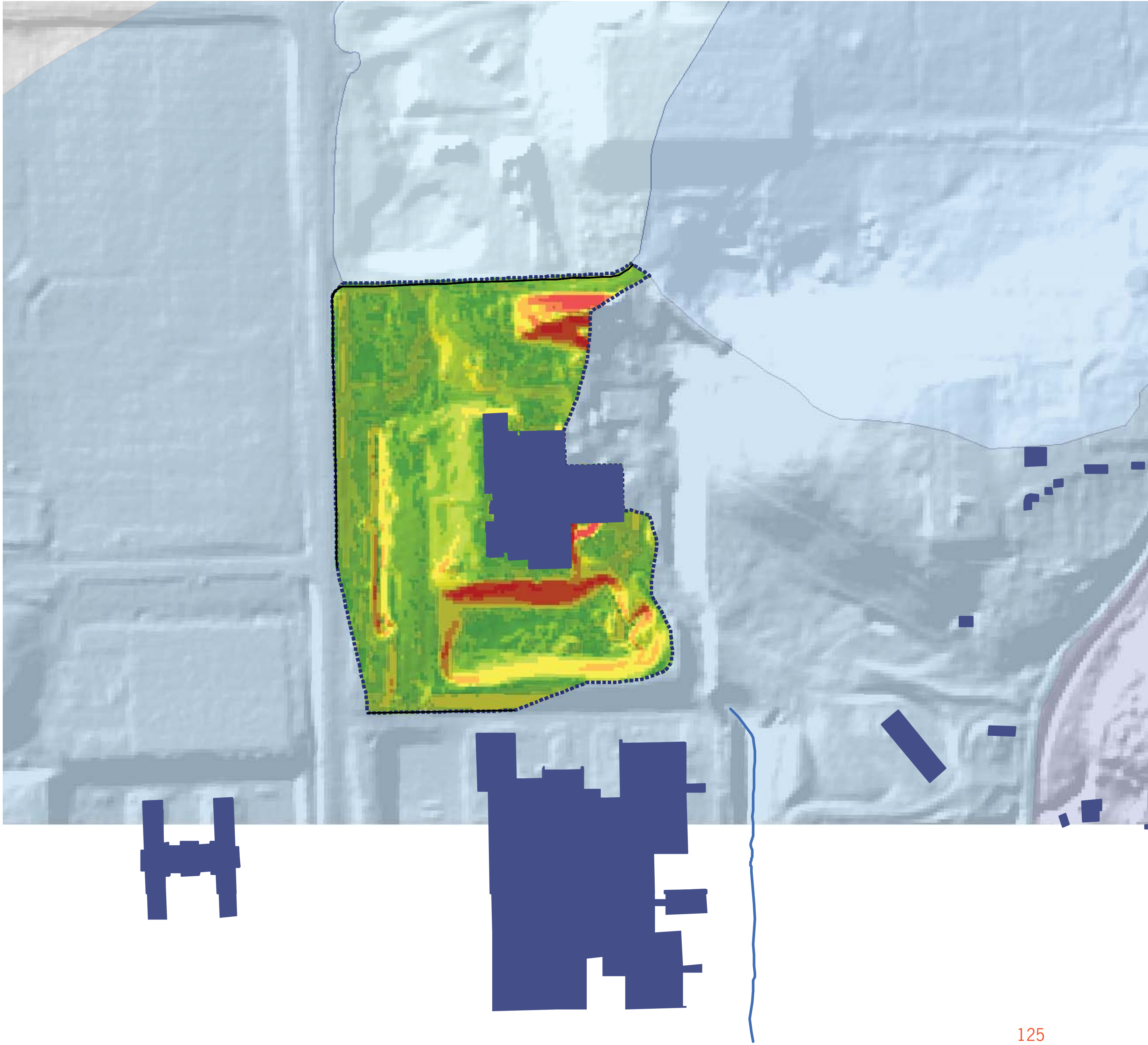


Figure A18 - Catchment 4 Slope Percentage and Hillshade (Meihaus 2008)



Glossary

Glossary

bank-full channel

The stream channel that is formed by the dominant discharge, also referred to as active channel, which meanders across the floodplain as is forms pools, riffles and point bars (Riley 1998, 405).

base flow

The flow that a perennially flowing stream reduces to during the dry season. It is supported by ground water seepage into the channel (Riley 1998, 405).

biodiversity

The variety of life and all the processes that keep life functioning, including the variety of different species (animals including humans, plants, microbes, and other organisms), the genes they contain, and the structural diversity in an ecosystem (Venhaus 2007, Glossary).

bioremediation

A process that uses biological agents, such as bacteria, fungi, or green plants, to remove or neutralize contaminants, as in polluted soil or water. Bacteria and fungi generally work by breaking down contaminants such as petroleum into less harmful substances. Plants can be used to aerate polluted soil and stimulate microbial action. They can also absorb contaminants such as salts and metals into their tissues, which are then harvested and disposed of. The use of green plants to decontaminate polluted soil or water is called phytoremediation (Venhaus 2007, Glossary).

check dam

A structure placed bank to bank downhill from a headcut on a hillslope to help re-vegetate a gully (Riley 1998, 405).

daylight

In the restoration field, a verb that denotes the excavation and restoration of a stream channel from an underground culvert, covering, or pipe (Riley 1998, 405).

discharge

The volume of water passing through a channel during a given time, usually measured in cubic feet per second (Riley 1998, 406).

dominant discharge

The channel forming discharge, which is equivalent to the bankfull discharge, responsible for the active channel that erodes and deposits, creates pools, riffle, and meanders. The discharge, in terms of flood frequency, usually has a return period or recurrence interval of 1.5 to 2 years in natural channels. This represents a flow condition where the stream flow completely fills the stream channel up to the top of the bank before overflowing into the floodplain (Riley 1998, 406).

eco-effectiveness

Not just being less bad. Asks the question “Am I doing the right thing?” in terms of seeking a delightfully diverse, safe, healthy, and just world, with clean water, air, soil, and power, that economically, equitably, ecologically, and elegantly enjoyed. (McDonough, William A. 2004)

ecological intelligence

A product or process designed to embody the intelligence of natural systems (such as nutrient cycling, interdependence, abundance, diversity, solar power, regeneration). (MBDC, Glossary of Key Concepts)

evapotranspiration

The process by which plants take in water through their roots and then give it off through the leaves as a by-product of respiration (Riley 1998, 406).

filter fabric

A polypropylene textile used to keep soil separate from water. Comes in many forms and is used for constructing roads, lining ponds, and in erosion control projects (Riley 1998, 406).

floodplain

The land adjacent to a channel at the elevation of a bank-full discharge, which is inundated on the average of about 2 out of 3 years. The floor of stream valley's, which can be inundated by small to very large floods. The one-in-100-year floodplain has a probability of .01 chance per year of being covered with water (Riley 1998, 406).

grade-control structure

A weir, dam, sill, drop structure, or other structure used to control erosion in stream channels with steep grades of where the slope has been destabilized (Riley 1998, 407).

greenbelt

Strip of natural vegetation growing parallel to a stream that provides wildlife habitat and an erosion and flood buffer zone. This strip of vegetation also retards rainfall runoff down the bank slope and provides a root system that binds soil particles together (Riley 1998, 407).

headcut

A break in slope at the top of a gully or section of gully that forms a "waterfall", which in turn causes the underlying soil to erode and the gully to expand uphill (Riley 1998, 407).

hungry water

Clear water, minus its expected suspended sediment, usually released from an impoundment that has excess energy, which erodes sediment from a downstream channel (Riley 1998, 407)

meander

A sinuous channel form in flatter river grades formed by the erosion on one side of the channel (pools) and deposition on the other (point bars) (Riley 1998, 408).

non-cohesive soil

Soil particles that have no natural resistance to being pulled apart at their point of contact, for example, silt, sand, and gravel (Riley 1998, 408).

rapid down-draw

Lowering the elevation of water against a bank faster than the bank can drain, leaving a pressure imbalance that may cause the bank to fail (Riley 1998, 408).

rational method or formula

A simple technique for estimating peak discharge rates based on average rainfall intensity (i), the drainage area (A), and the coefficient based on watershed characteristics (C). The discharge in cubic feet per second is derived from the following formula: Q = CiA. The rational method is commonly applied to areas as large as five square miles but is preferably used for drainage areas under a half square mile. The 2-, 5-, 10-, 25-, and 50-year flood recurrence discharges can be estimated with this formula (Riley 1998, 408).

reach

A section of a stream's length (Riley 1998, 408).

riparian

Referring to the riverside or riverine environment next to the stream channel, e.g., riparian, or stream-side, vegetation (Riley 1998, 408).

rip-rap

Heavy stones used to protect soil from action of fast-moving water (Riley 1998, 408).

root-wad

A tree stump with roots that are strategically placed in a stream bank as part of rebuilding or restoring the bank. The stump may be dead wood or live and capable of sprouting and rooting (Riley 1998, 409).

scour

The erosive action of flowing water in streams that removes and carries away material from the bed and banks (Riley 1998, 409).

sediment deposition

The accumulation of soil particles on the channel bed and banks (Riley 1998, 409).

sloughing

Movement of a mass of soil down a bank into the channel (also called slumping). Sloughing is similar to a landslide (Riley 1998, 409).

soil bioengineering

Also referred to as bio-technical slope protection. Involves the use of live and dead woody cuttings and poles or posts collected from native plants to re-vegetate watershed slopes and stream banks. The cuttings, posts, and vegetative systems composed of bundles, layers, and mats of the cuttings and posts provide structure, drains, and vegetative cover to repair eroding and slumping slopes (Riley 1998, 409).

terrace

An abandoned floodplain that is located at a higher elevation that the current active floodplain (Riley 1998, 410).

sustainability

The design, construction, operations and maintenance practices that meet the needs of the present without compromising the ability of future generations to meet their own needs .

urban equilibrium

This term is used to describe a channel that has changed from its natural or original shape but has finished adjusting to the urban influences affecting it so that it is relatively stable in its plan form and meander and has achieved a new balance in its bank-full width and depth, so that it is neither excessively eroding nor depositing and has healthy riparian growth (Riley 1998, 410).

watershed

An area confined by topographic divides that drains a given stream or river (Riley 1998, 410).

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