LIVE WORK OPERATIONS

COURTNEY WIERZBICKI
Kendall College of Art and Design of Ferris State University
Master of Architecture Thesis

Spring 2017

LIVE WORK **OPERATIONS**

COURTNEYWIERZBICKI
Kendall College of Art and Design of Ferris State University
Master of Architecture Thesis

Spring 2017

ACKNOWLEDGMENTS

ADVISORS
NedBaxter,MickMcCullochandBrianCraig
thankyouforyourguidance,knowledge,and
encouragementthroughoutthisthesisprocess.

CONSULTANTS
Thankyoutoallthosethatsharedtheirknowledge.

MatthewA.VanderEide,P.G.,CPG
SeniorProjectGeologistatSME

RickChapla
VPStrategicInitiativesatTheRightPlace

Wyoming Assessors Office

VolunteersattheWyomingHistoricalSociety

CLASSMATES
JennandBradweworkedthroughthisjourney
together;thankyouforallthesupport.

FAMILY
ThankyouforbeingbymysideasItookonthis
thesisjourney.Iloveyouall.

ARGUMENT

ABSTRACT

Thecurrentpost-industrialerahascauseda shiftinthesocialandculturalfabricofinner ringsuburbs.Asindustryfades,therelationship betweenlivingandworkinginthesecommunities hasbeentransformed.Manufacturingwasoncea centralpartoftheworkingclassinnerringsuburbs andhadprovidedjobs,economicstabilityand civicgrowth.Although,withincreasingtechnical advancementsandlowermanufacturingcosts inothercountries,manufacturinghasleftthese communitiesleavingadetrimentalvoid.The voidleftbymanufacturingfacilitieshasshifted theeconomy,fragmentedthe“Americandream,” and caused residents to find work outside of the community. In order to repair the void left by fleeing industry,anewrelationshipbetweenlivingand workingneedstobeconsidered.

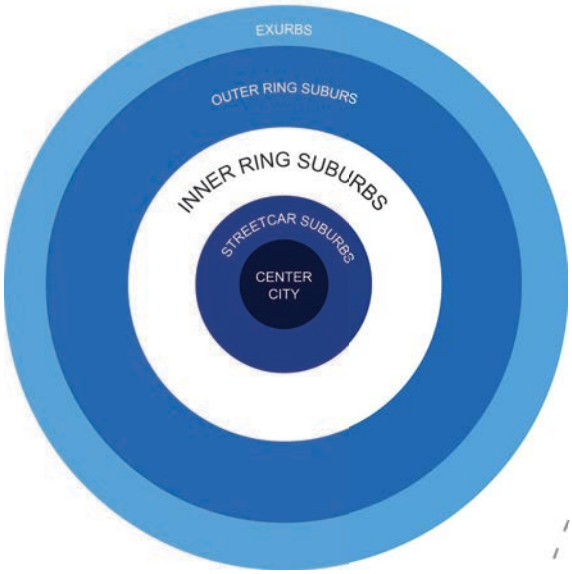
GodwinHeightsneighborhoodinthecityof Wyoming,Michiganhasgreatlybeeneffectedby thepost-industrialeramuchlikeotherinnerring suburbs.TheGeneralMotorsStampingPlant wascentraltotheGodwinHeightscommunity sincethe1930’s.Whenthefactoryclosedin 2009thecommunitylosttheheartofitseconomy andwasforcedtomakeeconomic,socialand culturalchanges.Asthemanufacturingpresence inGodwinHeightscontinuestoevolve,the integrationofsocialandeconomiclifebecomes moreimportant,andreimaginingtherelationship betweenlivingandworkingiskeytorepairingthe holesleftinthecommunity.

Drawinginspirationfromthemetalprocessesthat oncetookplaceonthesite,newrelationships betweenlivingandworkingcanbediscovered. Manufacturingfacilitieshavealwaysbeen operatorsonsuburbanfabricbycutting,piercing, andsheeringthroughneighborhoods.Toprevent futurevoidsinthefabricasindustryevolvesovertime, manufacturingshouldstretch,hem,bend,andweave manufacturingandlivingtogether.Therefore,when industrymeetsliving,thefabricofthecommunity istransformed,creatingnewandunexpected relationships.

Topreventfuturevoidsandprovideanageinplace community,threescalesoflivingandworking willbeimplementedonthesiteoftheprevious GeneralMotorsStampingPlant.Bydoingthis, itcreatesanetworkofcontinuoussupportand growth.Smallincubatorsorthinkspaceswillfeed prototypingfacilitiesthatthenfeedthethreelarge scalemanufacturingfacilities.Therefore;newideas, processes,andproductsarebeingcycledthroughfor lastingeconomicstability.Thethreescalesofhousing willprovidehousingopportunitiesforevolvingfamilies andindividuals,allowingthemtocontinueresidingon thesiteastheirneedschangeovertime.

Ultimately,thisthesisisabouttheunexpectedand unanticipatedrelationshipsthattransformtheway peopleperceivetypicalindustryandlivinginthe innerringsuburbsthroughthewaypeopleinteract withthosespaces.Whereindustryandlivingcome together,uniquespacesthatprovideoutreach, education,andsocialengagementareformed.This intersectioncreatesatransparencyintotoday’s manufacturingprocesses,strengthenscommunity engagement and fills the void left by old industry.

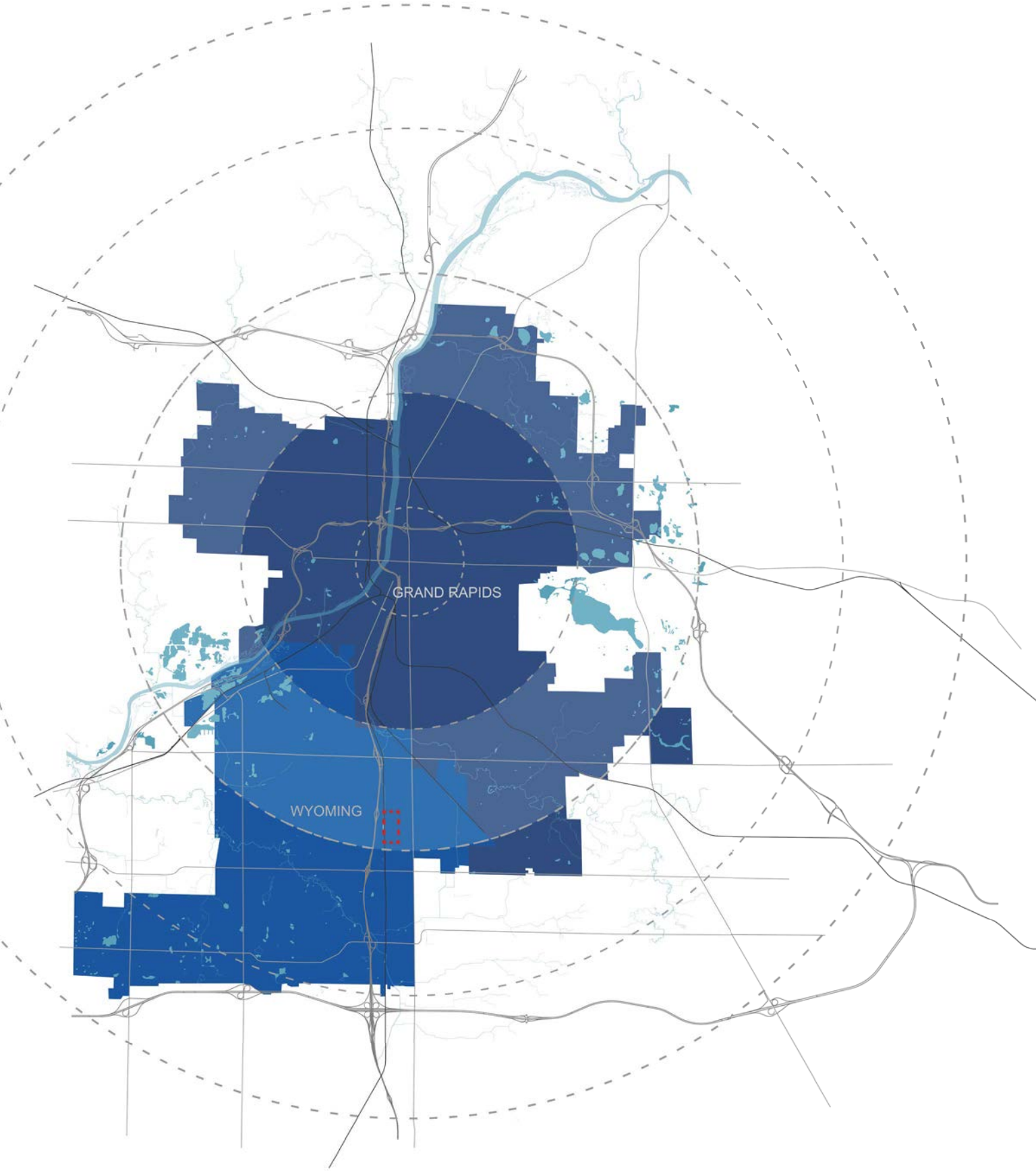
Image 1: Current condition at the site of the former General Motors Stamping Plant

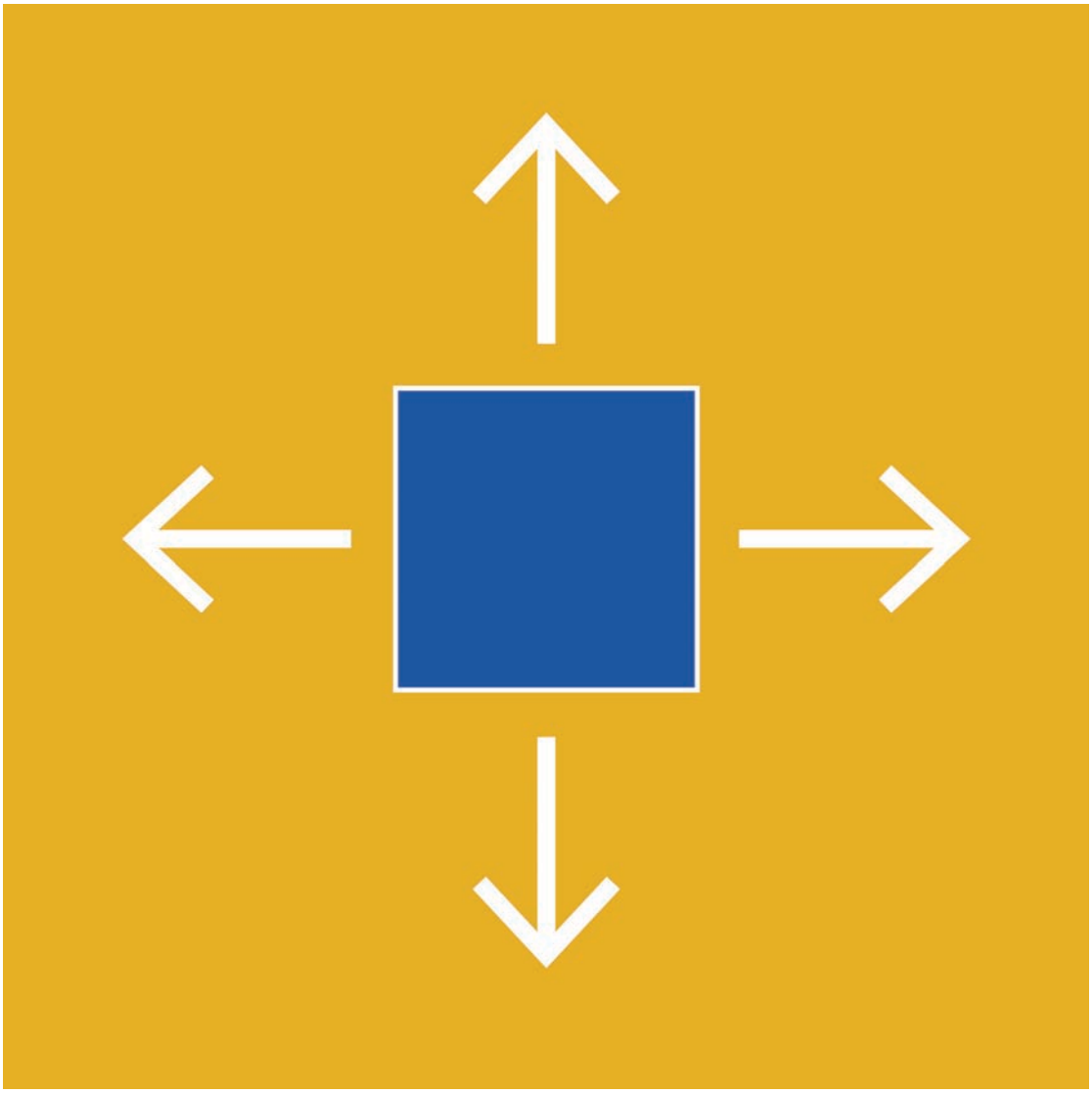


INNERRINGSUBURBS

The inner ring suburbs are often defined as a suburbancommunitythatislocatedincloseproximity tothecenterofthecity.Itsdensityislowerthenthat ofcentercityandthestreetcarsuburbs,buthasa densitythatishigherthentheouterringsuburbsand exurbs.Thisthesisfocusesontheinnerringsuburbs ofGrandRapids,MichiganwhichcurrentlyincludesTheCityofWyoming.

Image 2: Inner ring suburbs diagram


GRAND RAPIDS
WYOMING



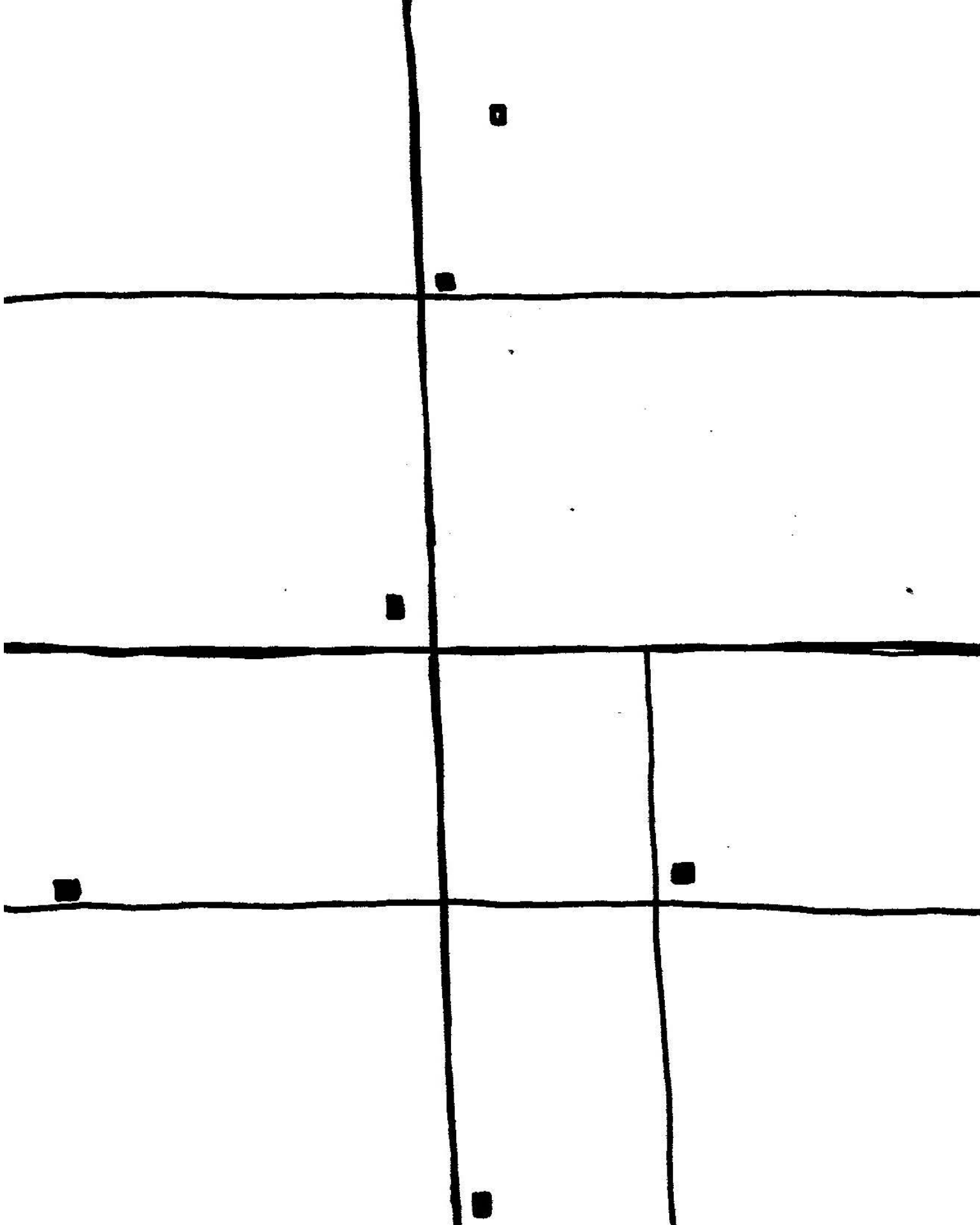
LIVE WORK RELATIONSHIP:

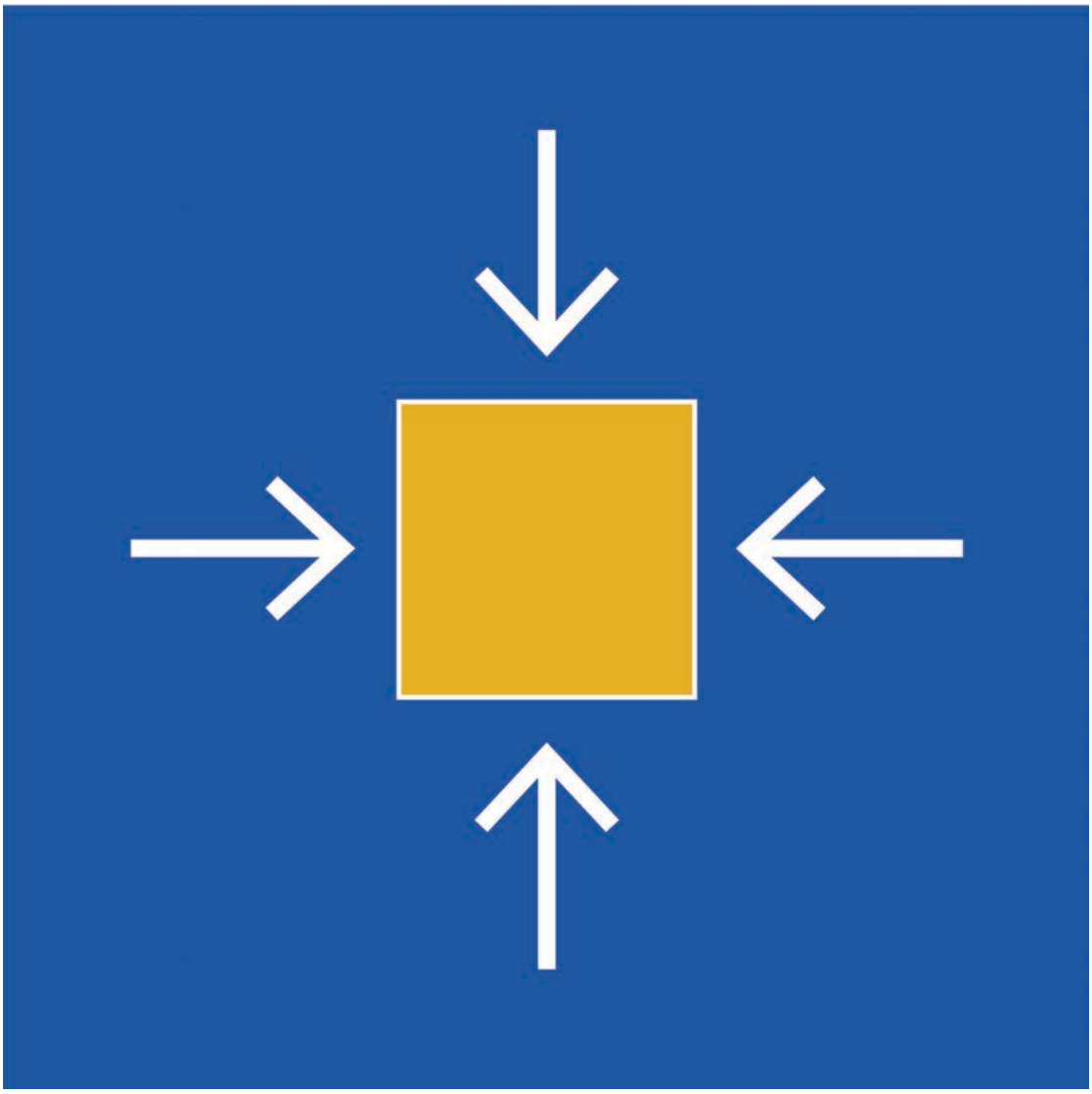
PRE-INDUSTRIAL + PRE-SUBURBAN INNER RING

LIVE = SINGLE FAMILY HOMES

WORK = FARM FIELDS

Image 3: Pre-industrial and pre-suburbs diagram





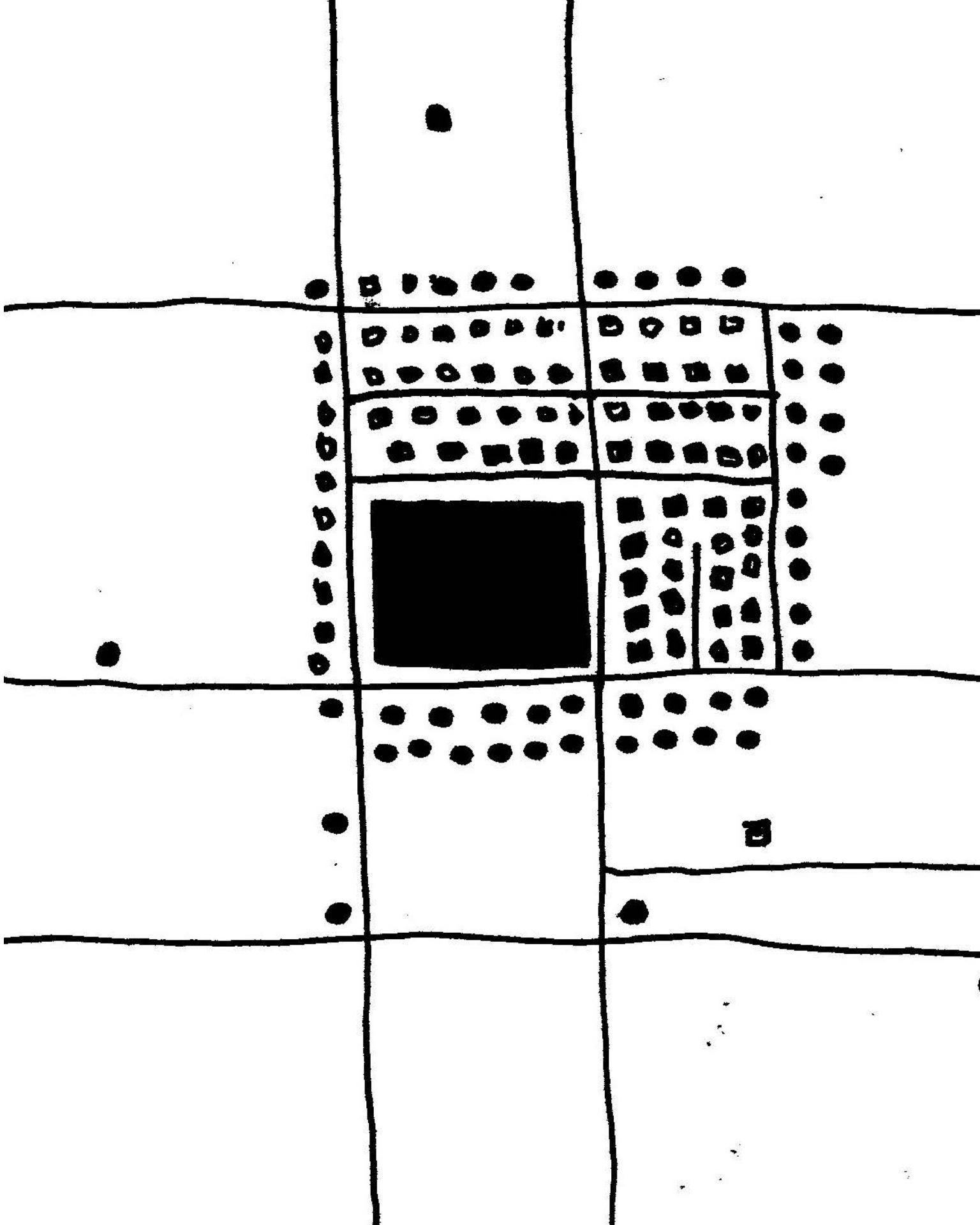
LIVE WORK RELATIONSHIP:

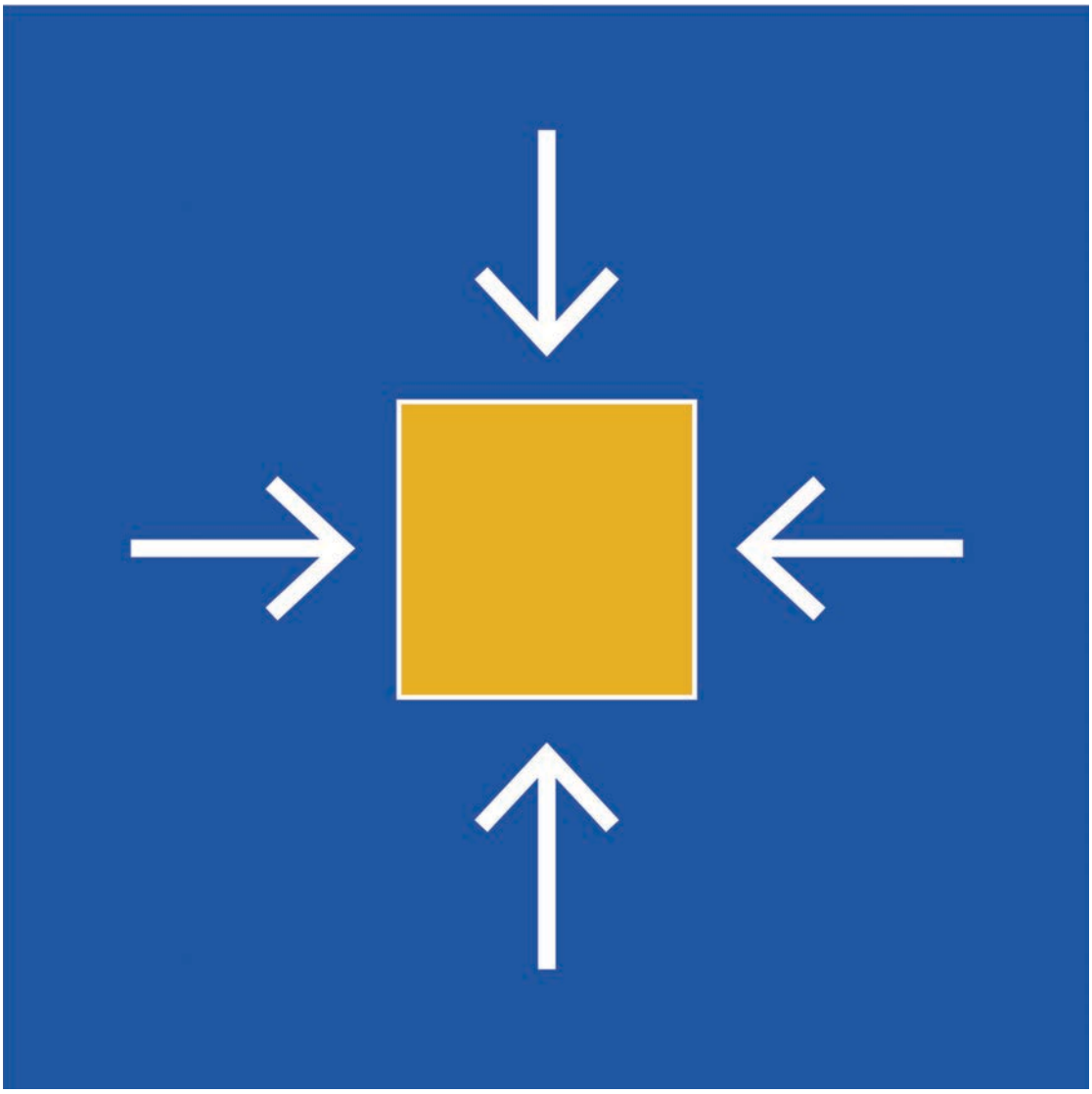
BEGINNING OF INDUSTRY + INNER RING SUBURBS

LIVE = SINGLE FAMILY HOMES

WORK = CENTRAL FACTORY

Image 4: Beginning Industry in the suburbs diagram





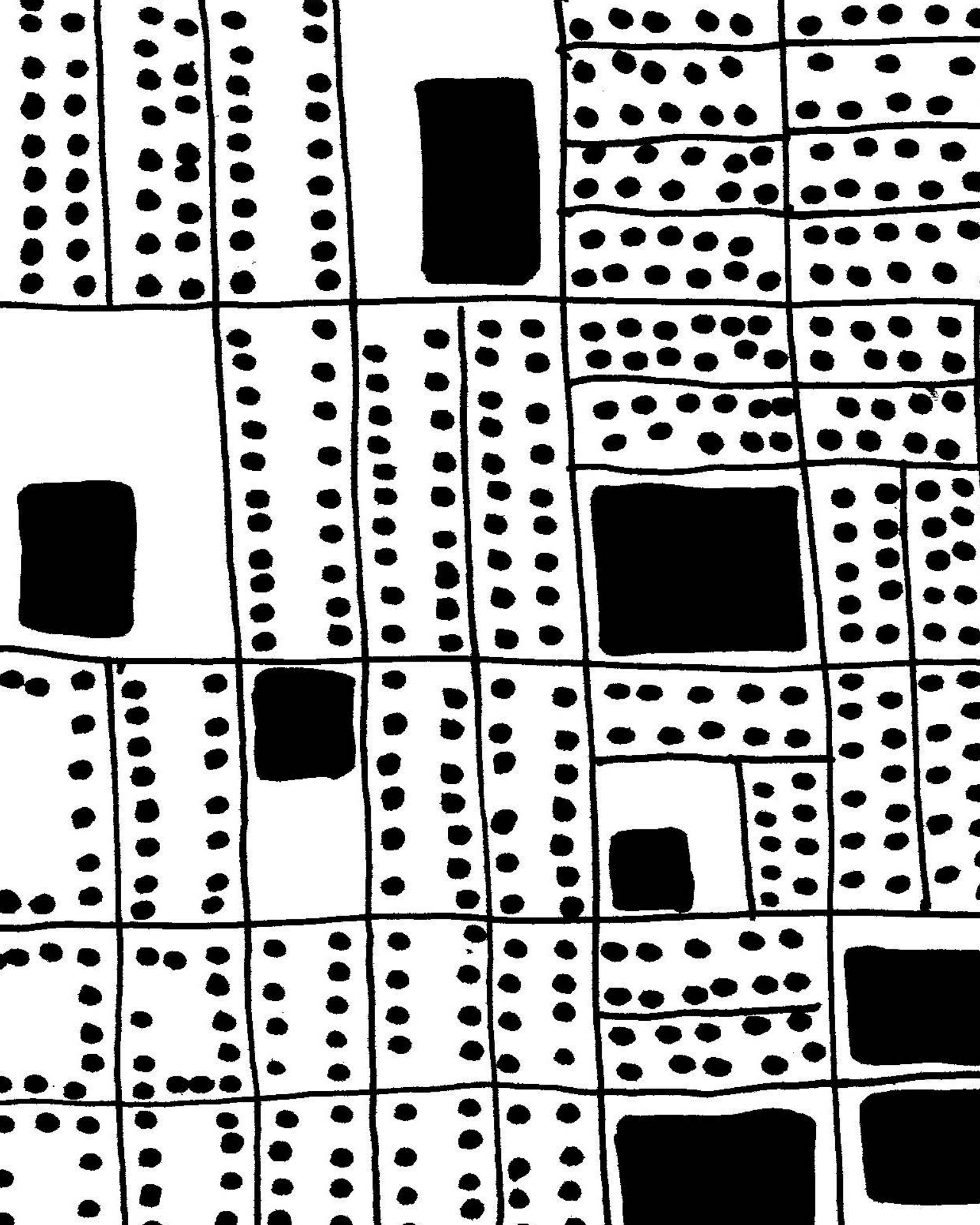
LIVE WORK RELATIONSHIP:

BOOMING INDUSTRY IN THE INNER RING SUBURBS

LIVE = SINGLE FAMILY HOMES

WORK = CENTRAL FACTORY

Image 5: Booming industry in the inner ring suburbs diagram



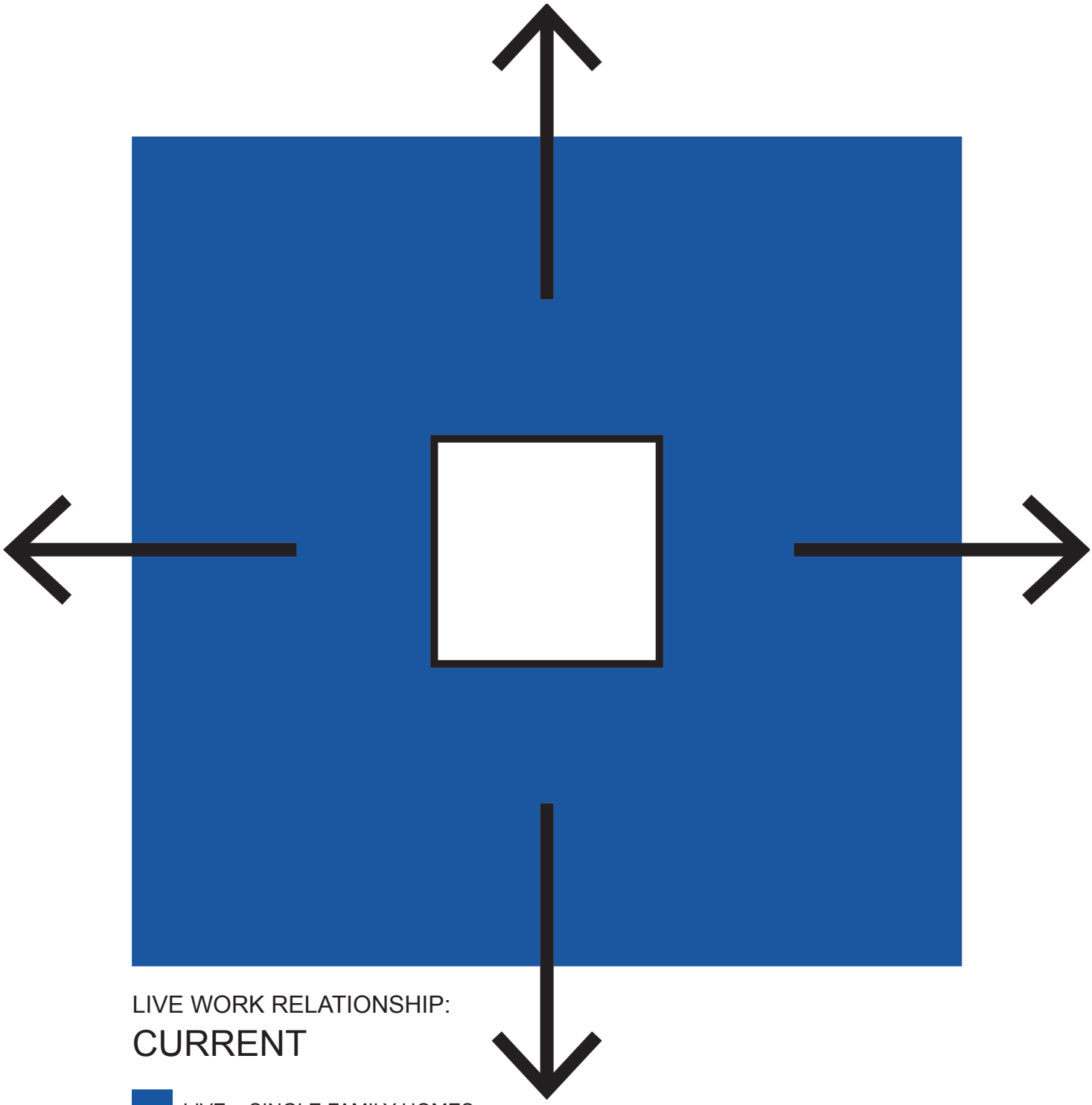
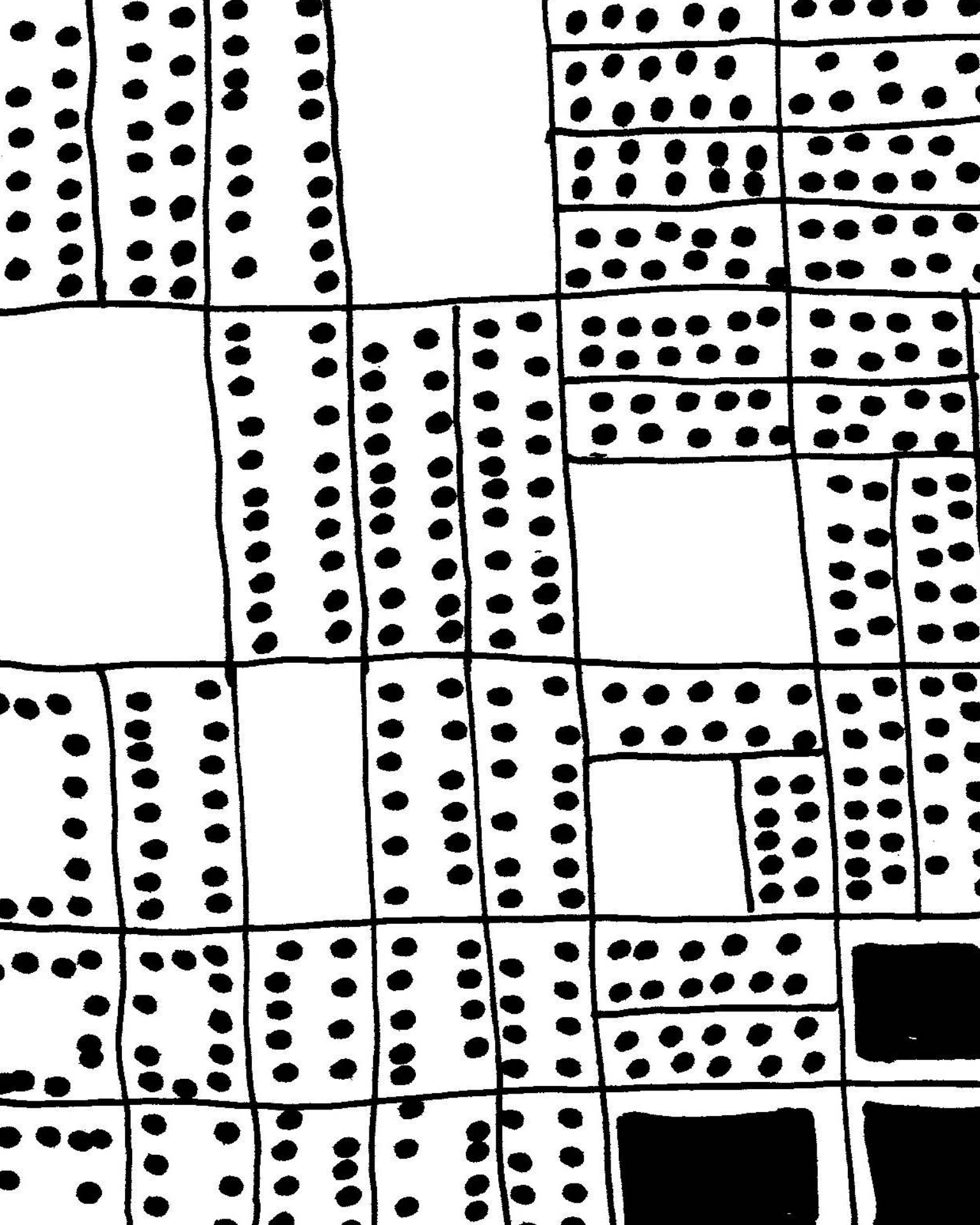


Image 6: Current conditions diagram



GODWINHEIGHTS

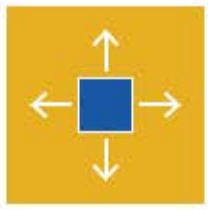
TheneighborhoodofGodwinHeightsexistsbecause oftheGeneralMotorsStampingPlant.TheStamping Plantdrewpeopletotheneighborhoodduringthe GreatDepressioninhopesofprovidingabetterlife fortheirfamilies.GodwinHeightshasfolloweda similarevolutionofotherinnerringsuburbsmaking thesiteoftheoldGeneralMotorsStampingPlant inWyoming,Michiganagreatplacetorethinkthe relationshipbetweenlivingandworking.

Image 7: Google maps aerial image

PHASE 1: PRE-INDUSTRIAL AND PRE-SUBURBAN WYOMING

The relationship between living and working has greatly evolved since the nineteenth century. What are now considered inner ring suburbs began as agricultural land, and were only later transformed into industrial hubs. In nineteenth century Wyoming township, farming and its related services were central to the local economy.[1] The growing of corn for corn meal and wheat for flour were two of the major agricultural sectors in the Wyoming region, among many others.[2]

The relationship between living and working was very different in the agricultural era than it is today. Housing during this time was a much smaller portion of the fabric. Single family houses were scattered acres apart and surrounded by farmland, or "work" in the terms of this thesis. Essentially, the house, or living, was central and work surrounded it. (see diagram to the right) Social spaces, were mostly non-existent as they are neither work or housing.



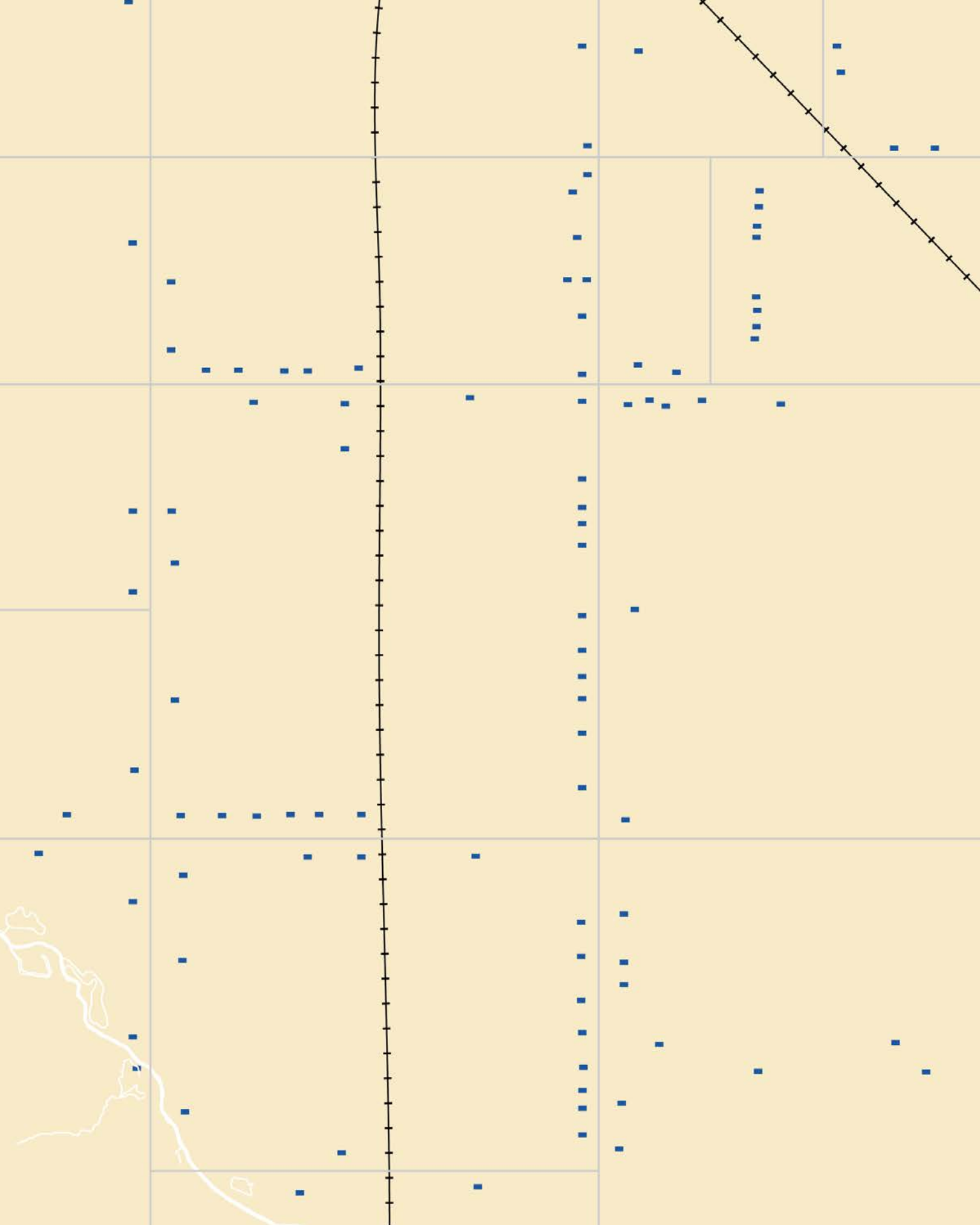
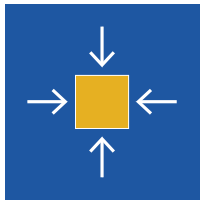


Image 9: Zandstra family on farm located on the site of the General Motors Stamping Plant

PHASE2:BEGINNING OFINDUSTRY ANDTHE SUBURBS

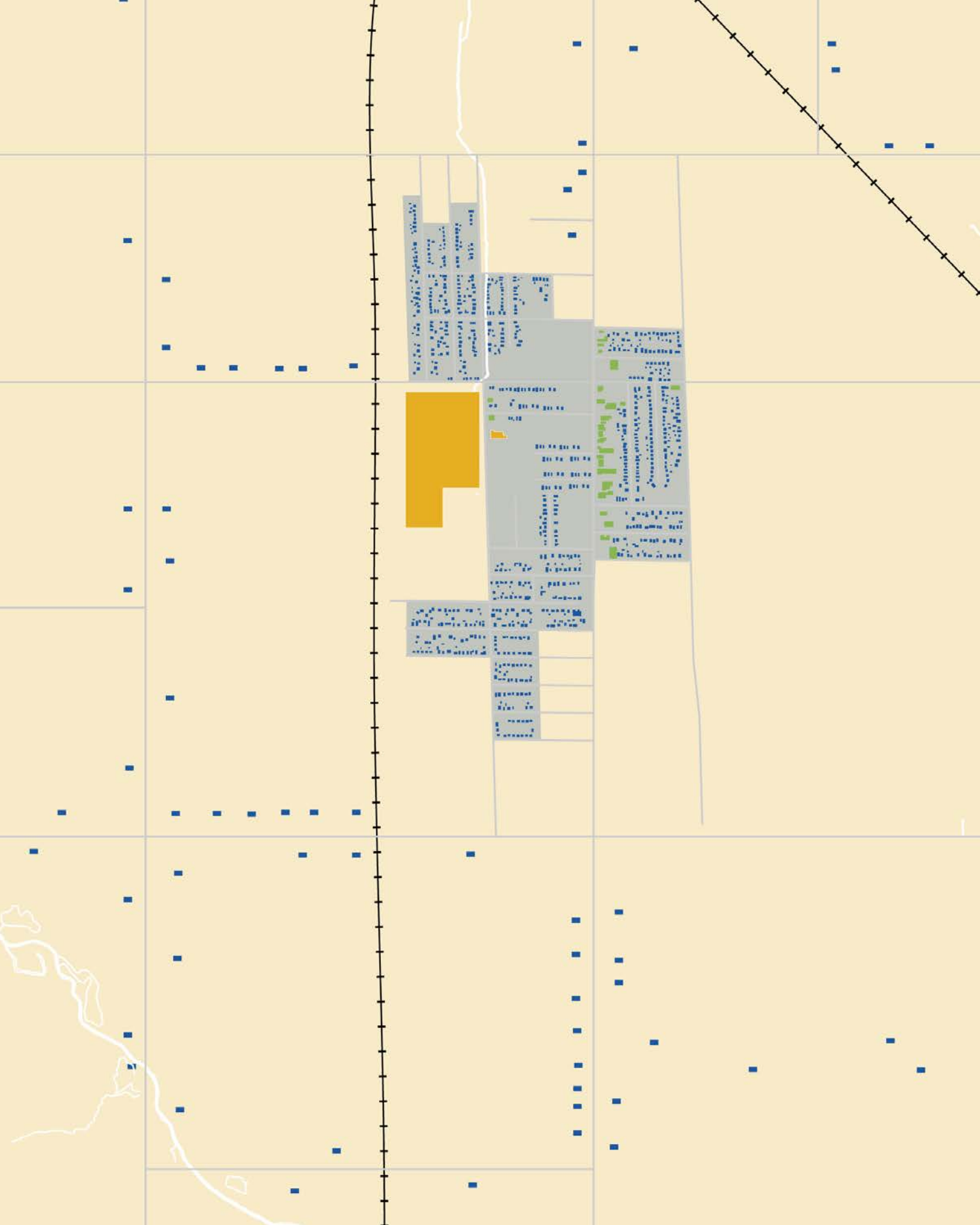
In1935,whentheannouncementwasmadethat GeneralMotorswascomingtoWyoming,muchofthe townshipwasstilllargelybasedaroundagriculture. [3] GeneralMotorspurchasedthelandfromMrs. BenjaminHanchett,widowofthepresidentofGrand RapidsStreetRailway.Atthattimethelandwas rented fortheuseofgrowingandharvestingcrops. [4] Havingbeenconstructedinoneoftheworstyearsof theGreatDepression,theGeneralMotorsStamping Plantspurredrapidgrowthbothresidentiallyand commercially.TheWyomingneighborhoodof GodwinHeightsemergedaroundtheplant,gainingа reputationasanindustrialcenter. [5]

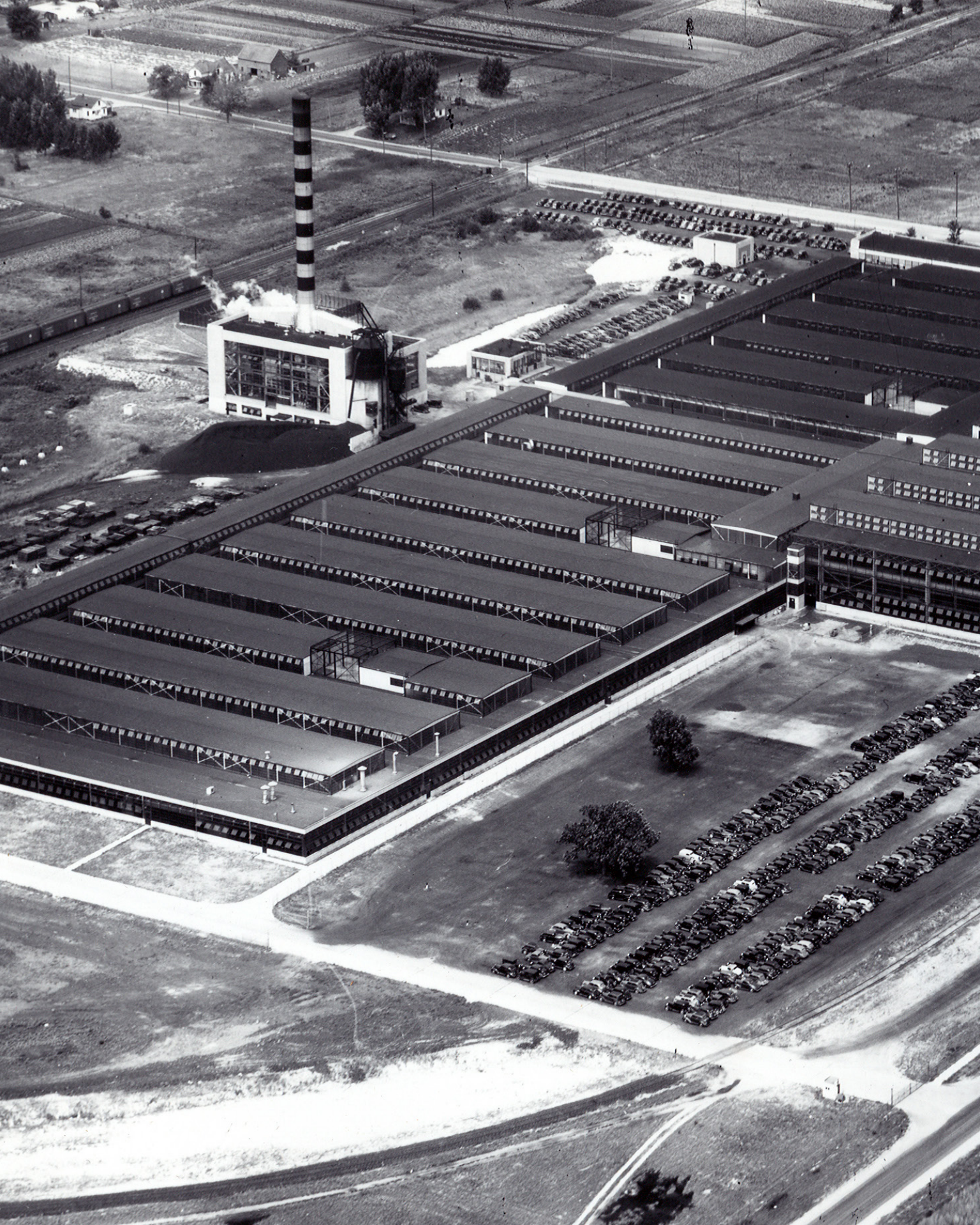
Aspeoplebegantouproottheirlivesinthecityto workinfactoriesinthegrowinginnerringsuburbs, therelationshipbetweenlivingandworkingbeganto change.Industrybecamecentral,andtheresidential fabricgrewuparoundit(seediagramtotheright). Peoplesoughtoutplacestolivearoundwherethey worked.Living,workingandrecreationspaceswere developedwithinthecommunitybutwerephysically separatefromeachother.Multiplegenerationsof WyomingresidentsworkedattheGeneralMotors StampingPlantthroughoutthetwentiethcentury. Thefactoryultimatelybecamecentraltonotonly theeconomyofGodwinHeights,butalsotothe community.[6]



3 Ibid., 121.
4 John Cassleman, History of John Cassleman and General Motors in Wyoming, Michigan. Grand Rapids, John Cassleman, 2011.
5 Charles Vaughn, and Dorothy Simon, The City of Wyoming: A History, 123-124.
6 Bunn, Austin and Christopher Lewis, Rust, Working Group Theatre, 8 Nov. 2012., https://www.youtube.com/watch?v=rXGQz653Syw, Accessed 3 Dec, 2016.

Image 10: Residential fabric growing around new industry in Godwin Heights





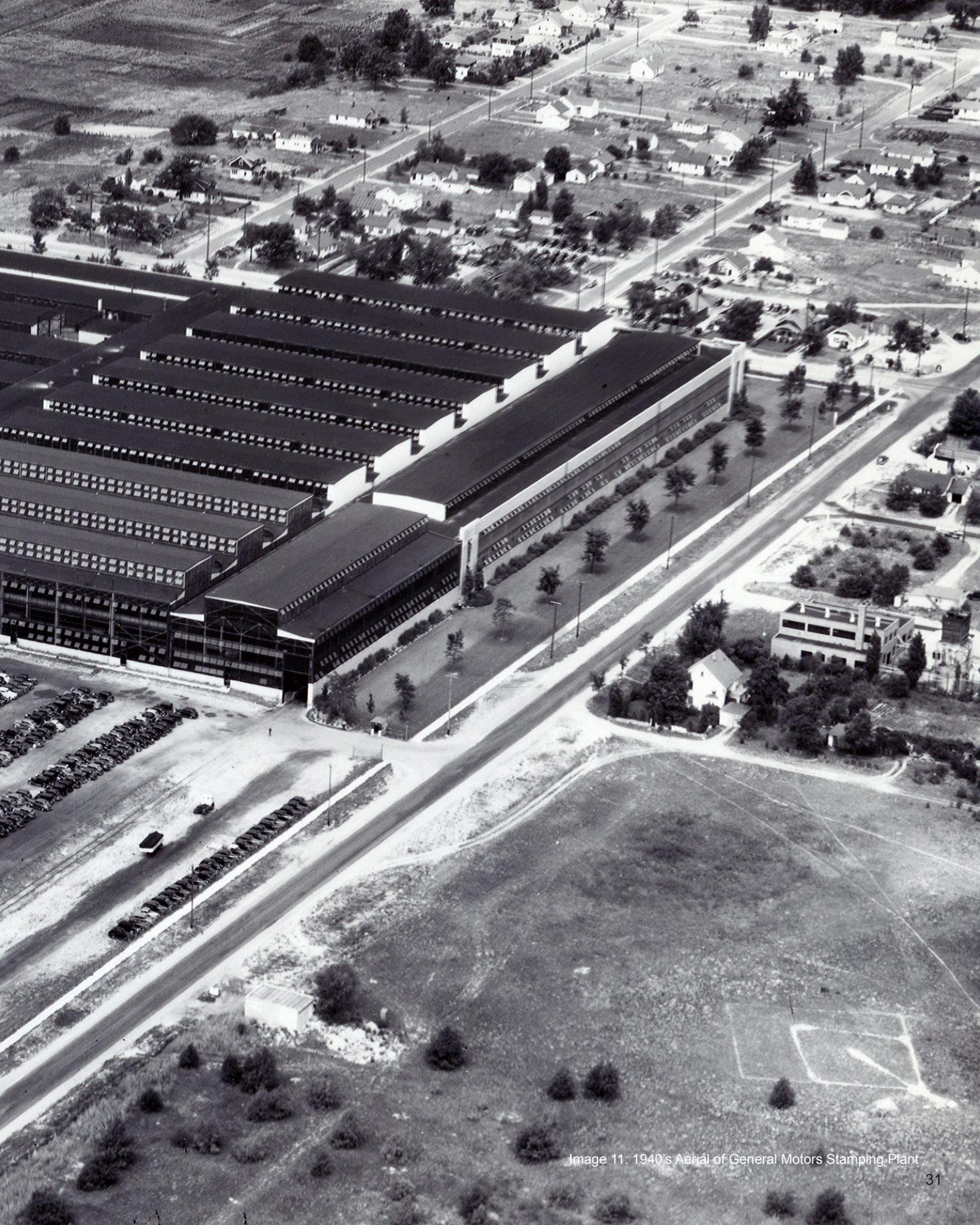


Image 11: 1940's Aerial of General Motors Stamping Plant

PHASE 3: BOOMING INDUSTRY IN THE INNER RING SUBURBS

Godwin Heights continued to grow and thrive off a large industrial base. When the airport moved from its location just east of the General Motors Stamping Plant in the 1970's, tax breaks were given to industrial and commercial firms who began development on the site. This political decision contributed to the ultimate shaping of Godwin Height's residential fabric.[7] The industrial buildings that were built in place of the airport continued to shape Godwin Heights, and cut through the suburban fabric.

As industry continued to operate on the fabric of Godwin Heights, the relationship of living and working continued to grow as separate entities. Much of this separation was due to the introduction of zoning laws and building codes in the suburbs.[8] Zoning laws for example, favored functional separation from living spaces to "protect" them from the encroachment of working and industrial spaces. With zoning laws causing increased separation between living and working, industry began to have a greater effect on the Godwin Heights neighborhood. As industry continued to develop in the inner ring suburbs, it began to dismantle the residential fabric and create physical barriers. With each new industrial facility, the existing residential fabric of the neighborhood was being altered.

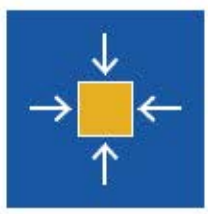
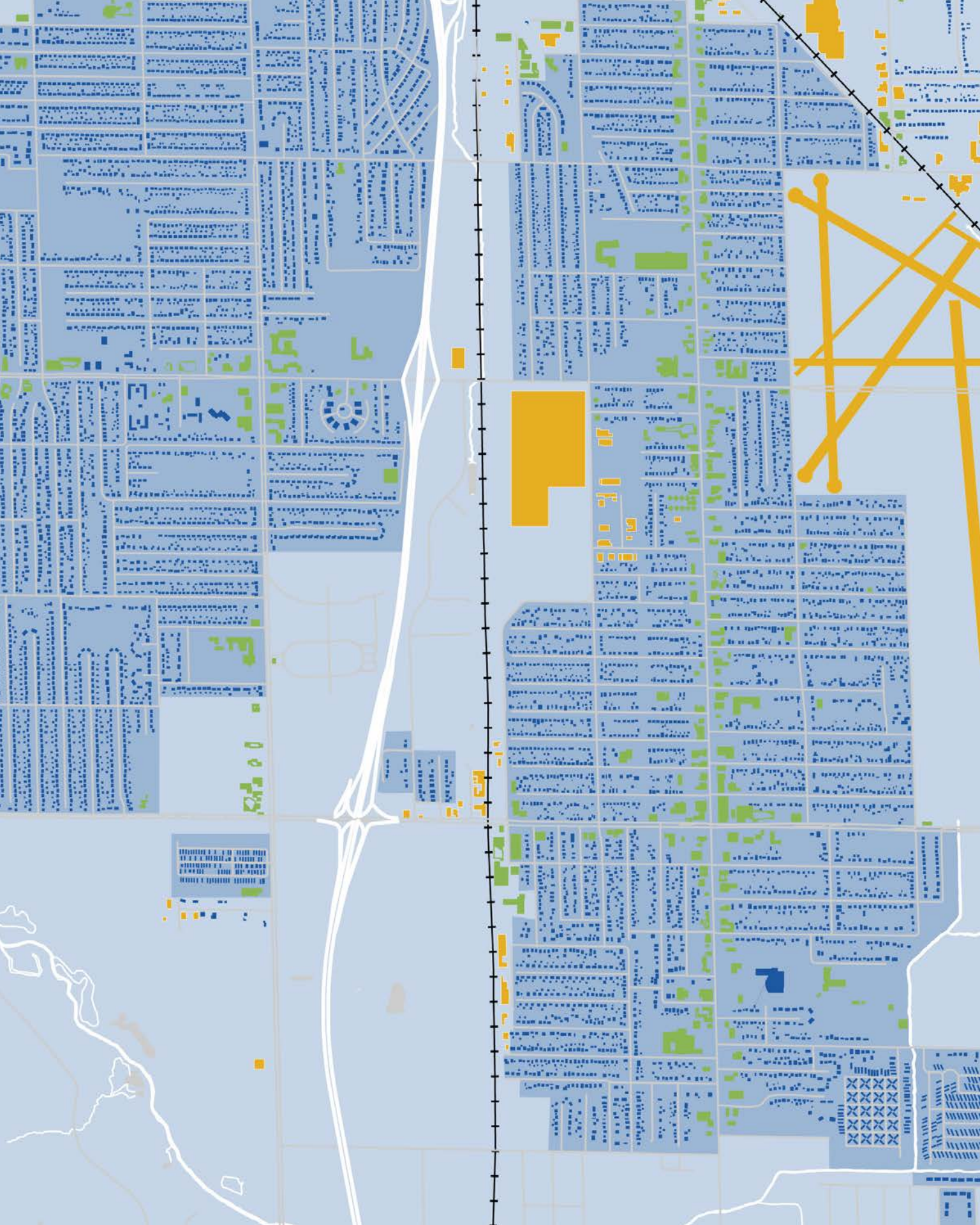


Image 12: Continued industrial growth in Godwin Heights



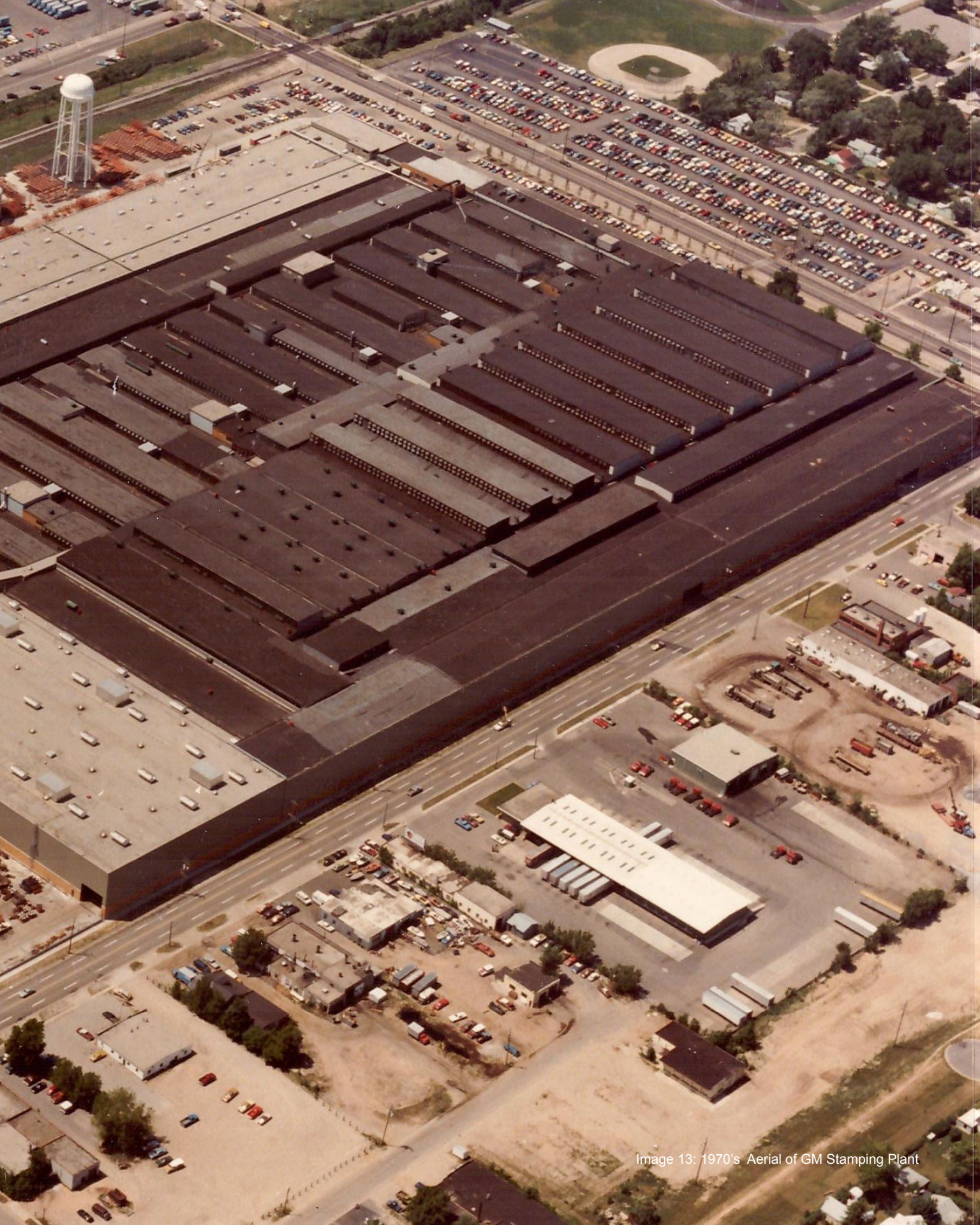


Image 13: 1970's Aerial of GM Stamping Plant

PHASE4:DECLINEOF INDUSTRY

Inthemidtolatetwentiethcentury,immenseamounts of industry fled to other countries because of technical advancementsandlowerproductioncosts. [9]Withindustry centraltomanyinnerringsuburbancommunities,the declineofindustrybegantogreatlyaffectthepeopleandthe communitiesaroundthem.GodwinHeightswasespecially impactedwhentheGeneralMotorsStampingPlantclosed in2009.Theplantwastheheartofthecommunityandan essentialpartofitsfabric.Whentheplantclosed,itlefta gapinghole,andturnedthelivingandworkingrelationship upsidedown.Although,thereareanumberofsmaller industrialoperatorsthatcontinuetooperateintheGodwin Heightsneighborhood,theydonotcreatetheamountor typeofhighpayingjobsthatGeneralMotorsoncedid.What wascentraltothecommunityisnowavoid,andpeople were forced to find work outside of the community creating a largergapbetweenlivingandworking.

PHASE5:CURRENT CONDITIONS

AftertheGreatRecession,manufacturinghasincreased bothinproductionoutputandemploymentintheUnited States.WagesincountriessuchasChinacontinuetorise causingjobstoreturn. [10] Continuing into the twenty first century,theamountofhighlyautomatedproductionfacilities willincreaseintheUnitedStateswhilemorephysical laborintensiveproductionwillremainoverseas. [11]Asthe manufacturingpresenceinGodwinHeightscontinues toevolve,theintegrationoflivingandworkingor“social andeconomiclife”becomesmoreandmoreimportant. [12] Reconsideringthisrelationshipiskeytorepairingtheholes incommunitiescausedbytheshiftinmanufacturinginthe postindustrialera.

9 Nicolas Ronderos, “Stabilization of the U.S. Manufacturing Sector and Its Impact on Industrial Space,” NAIOP Research Foundation (2013): 5.
10 Ibid., 19.
11 Ibid., 26.
12 Howard Davis, Living Over the Store: Architecture and Local Urban Life, 4.

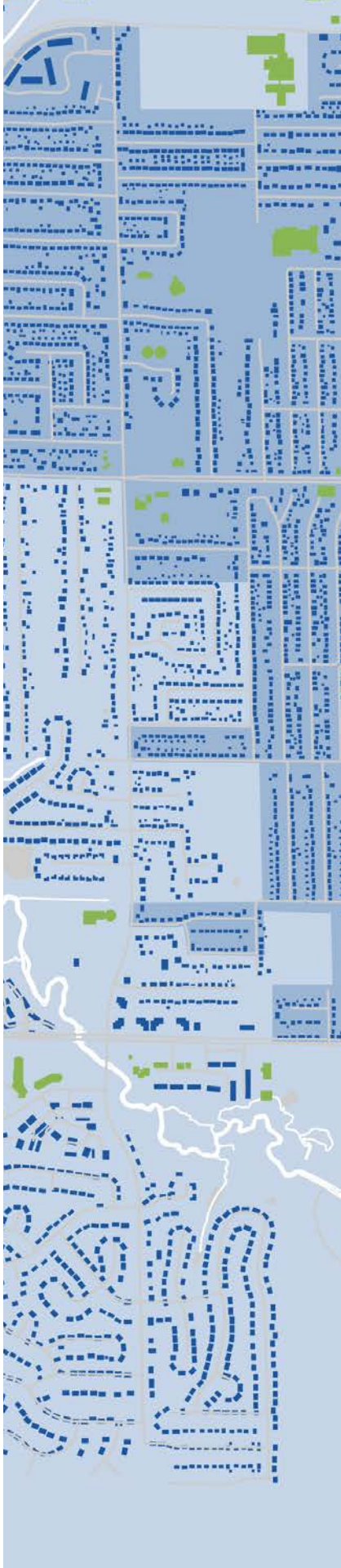
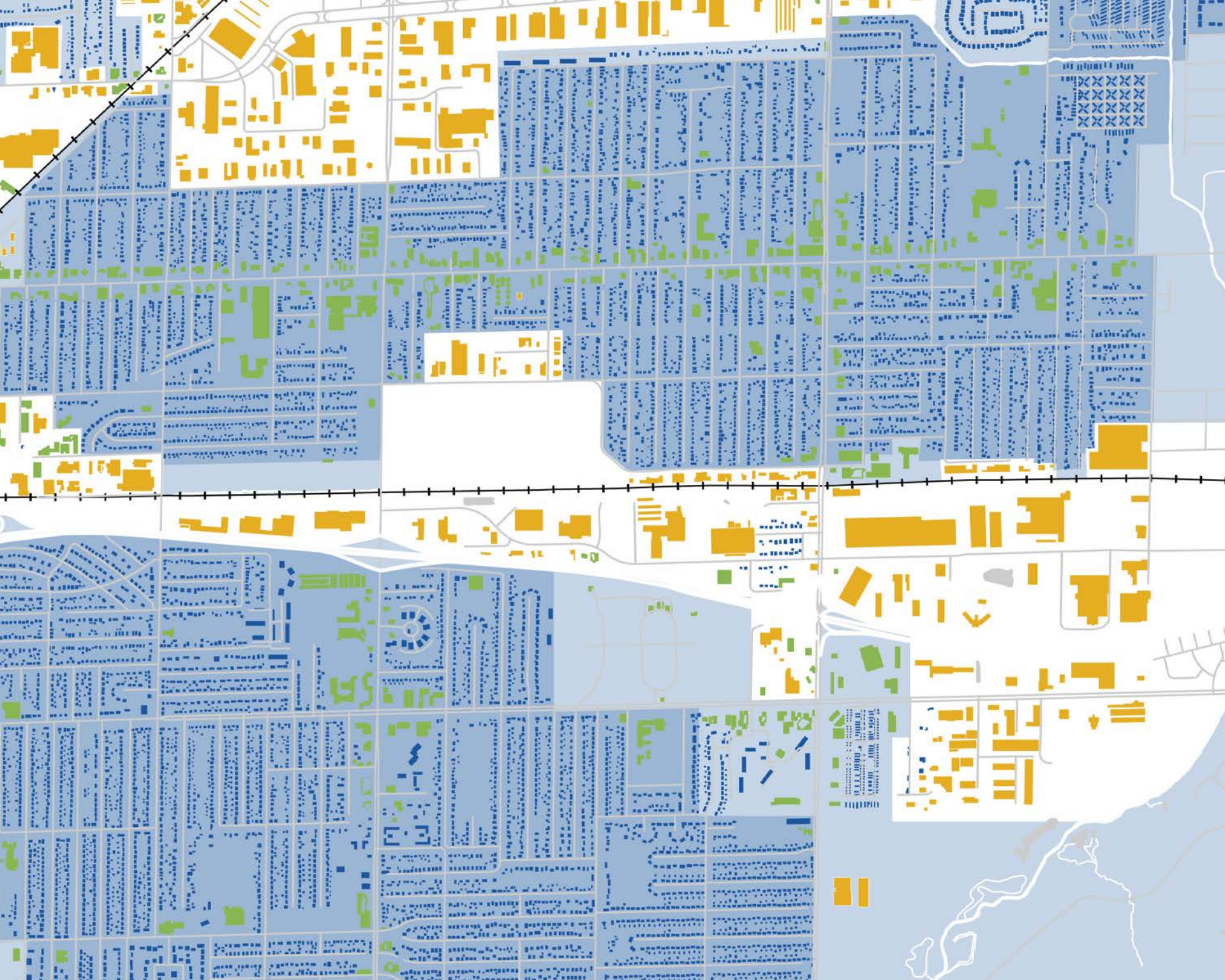


Image 14: Current effects left by industry on the suburban fabric in Godwin Heights




GRAND RAPID
30

Image 15: Demolition of General Motors Stamping Plant

Prior to 1935

The 77 acres was home to the Zandstra Farm.

1936

In January, construction began on the site.

2009

The plant officially closes.

1935

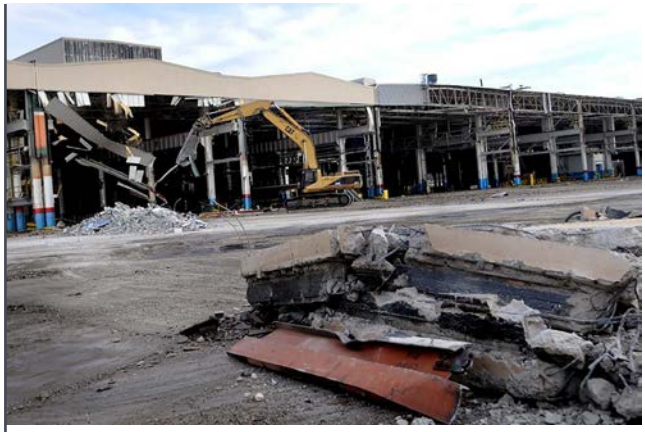
The Grand Rapids Press announces that Fisher Body and GM will build a plant in Wyoming.

1936

In April, a line of applicants stretch for a mile down Buchanan Ave and extending along Division Ave in hopes for a better job.

2008

General Motors announced that the plant would close by the end of 2009.



2011-2012
The building is demolished.

2012-Present
Site remains vacant and in search of new tenants.

“Ihadagreatcareerthere,GM gavemetheopportunityand acoupleofrisks.Losingajob isarisk.Gettingsickisarisk”

GENERALMOTORS STAMPINGPLANT

OnDecember20th,1935theGrandRapids PressandGrandRapidsHeraldNewsboysrode throughoutdowntownGrandRapidsyelling“extra extrareadallaboutit!”Theheadliningstorythat daywastheannouncementthatGeneralMotors andFisherBodyweregoingtobuildafactoryin Wyoming.[13]

TheFactorywasgoingtotaketheplaceofZandstra’s farmon36thStreetduringoneoftheworstyearsof theGreatDepression.Constructionbeganonthe sitealmostimmediatelyaftertheannouncementwas made.InJanuary,1936,constructiononthesite beganwith2000menworking.Threemonthslater, onApril6thapplicantslookingforabetterlifeand betterjoblinedthestreetforamilealongBuchanan Ave,andanotherextendingalongDivisionAve.Many ofthemenandwomanhadquittheirjobstocome standinlineattheGeneralMotorsPlant. [14]

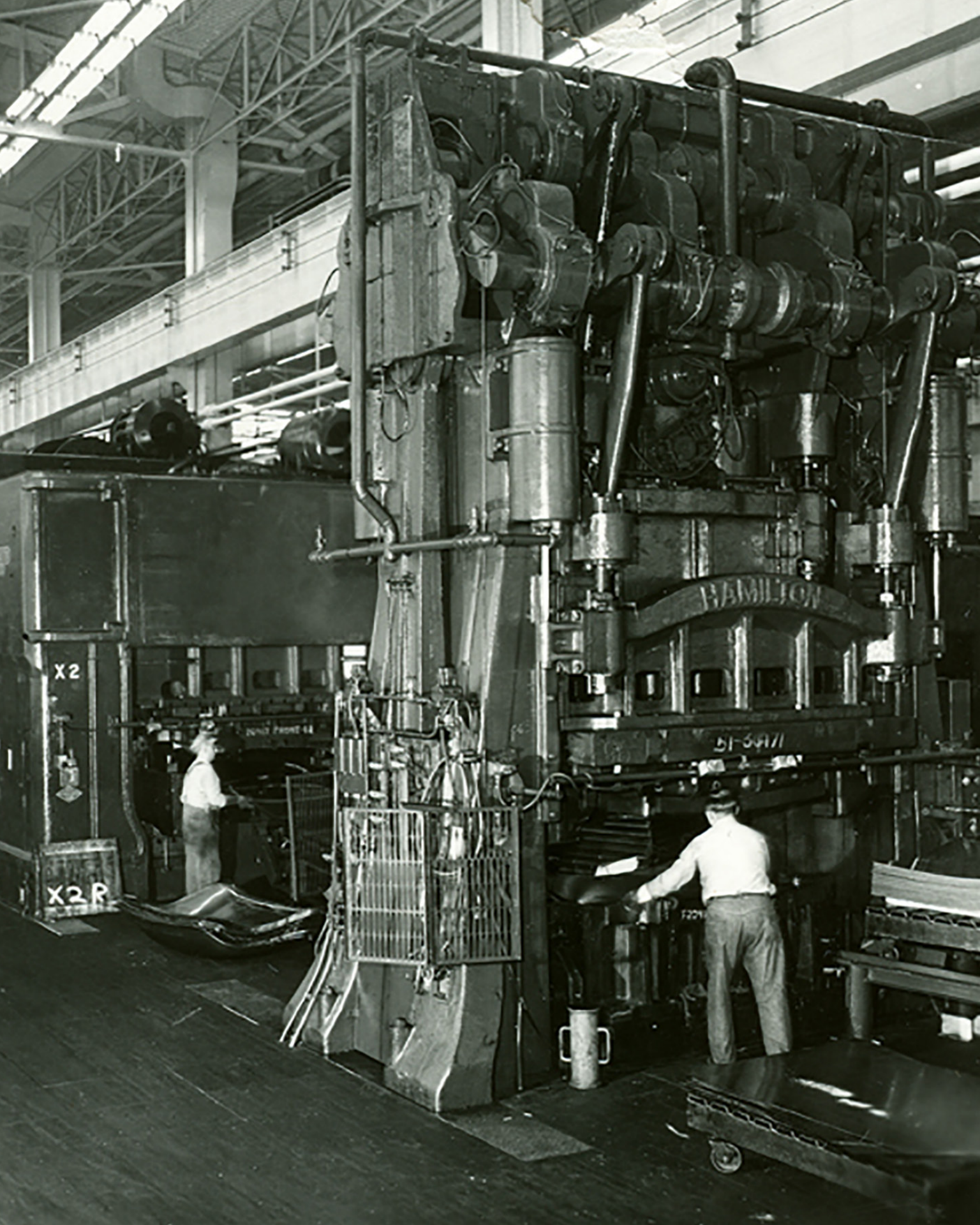
TheGeneralMotorsStampingPlantatconception wasthelargestsinglestructureerectedatonetimein thehistoryofGeneralMotors.Andinitshaydaywas one of the most profitable and productive stamping facilities.[15]

In2008,GeneralMotorsannouncedthattheywould beclosingthe36thStampingPlantbytheendof 2009.Employeesandpeoplewithinthecommunity weredevastated.Notonlydidtheplantprovide internaljobs,butitspresencealsoaffectedother companies that benefited from and depended on the facility.Theplantclosurein2009wasahugelowfor theneighborhood,butthelargevacantsitetoday providesanopportunitytorethinktheAmericanlive workparadigm. [16]

13 Cassleman, John. History of John Cassleman and General Motors in Wyoming, Michigan. Grand Rapids, John Cassleman, 2011.
14 Ibid.
15 Ibid.
16 Bunn, Austin and Christopher Lewis. Rust, Working Group Theatre, 8 Nov. 2012., https://www.youtube.com/watch?v=rXGQz653Syw. Accessed 3 Dec. 2016.

Image 16: General Motor Stamping Plant timeline showing growth and decline

Image 17: Current condition of former General Motors Stamping Plant


X2
X2R
HAMILTON

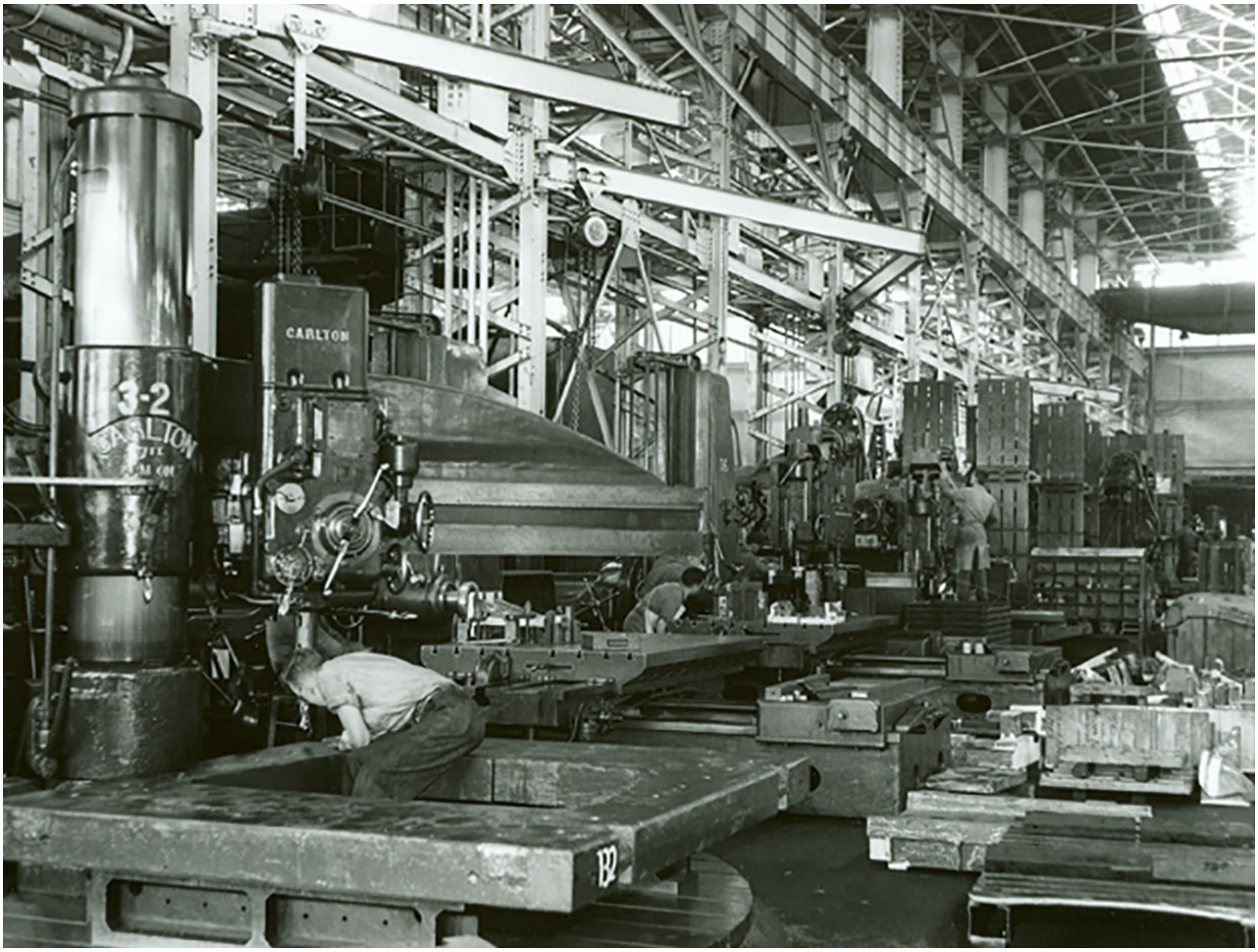


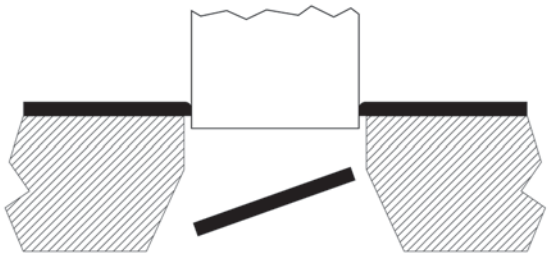
Image 19: Photograph of men working at the General Motors Stamping Plant 1940's

GIVINGFORMTOFABRIC

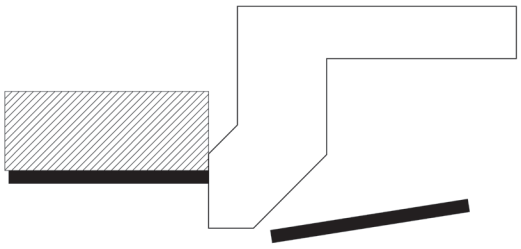
Metalstampingprocesseswereevaluatedasaway torethinktherelationshipbetweenlivingandworking intheinnerringsuburbs.Inordertorepairthevoid inGodwinHeightsfabric,metalprocessessuchas stretching,hemming,andweavingwillbringliving andworkingtogetherinnewandunexpectedways. Theseoperationswillalsobringasenseofplaceand historytothecurrentlyvacantsite.

Image 18: Photograph of men working at the General Motors Stamping Plant 1940's

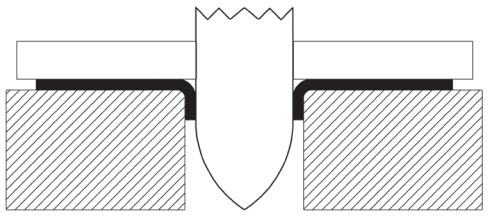
CUTTINGOPERATIONS



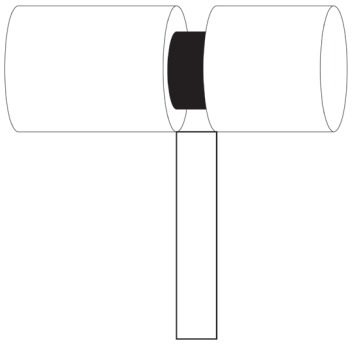
Blanking



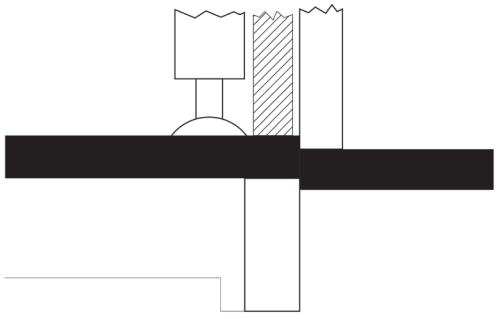
Trimming



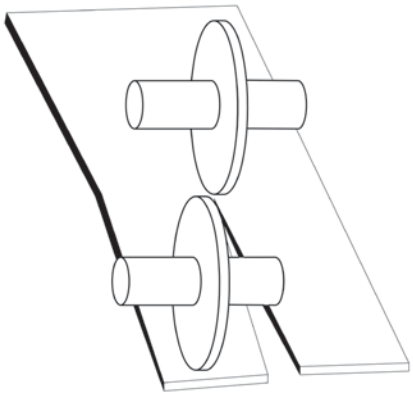
Piercing



Parting



Shearing

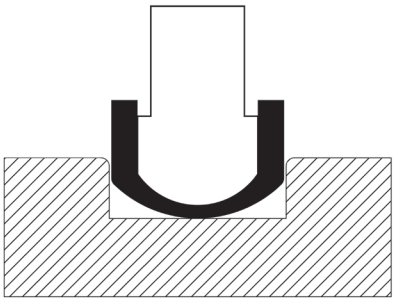


Slitting

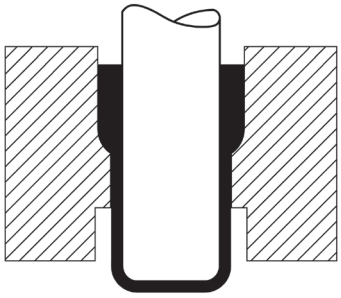
Image 20: Machine slitting sheet metal (Left)

Image 21: Cutting metal operations

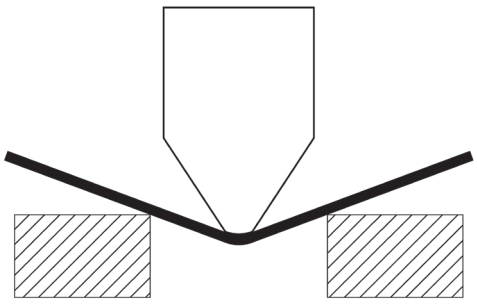
PRESSINGANDFORMINGOPERATIONS



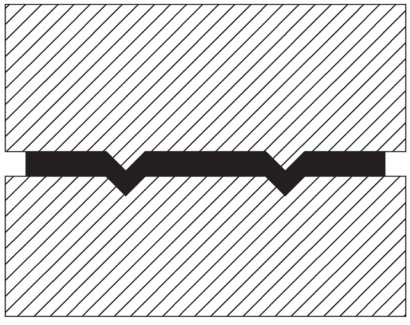
U-Bending



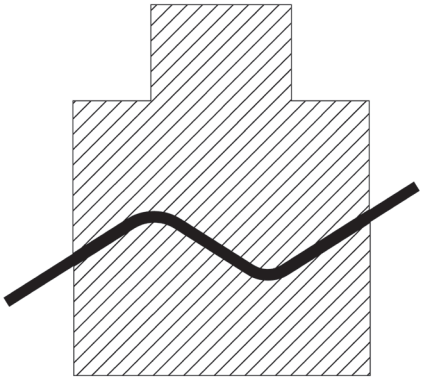
Deep Drawing



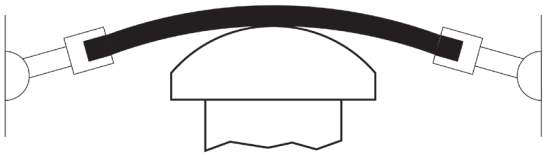
Air Bending



Embossing



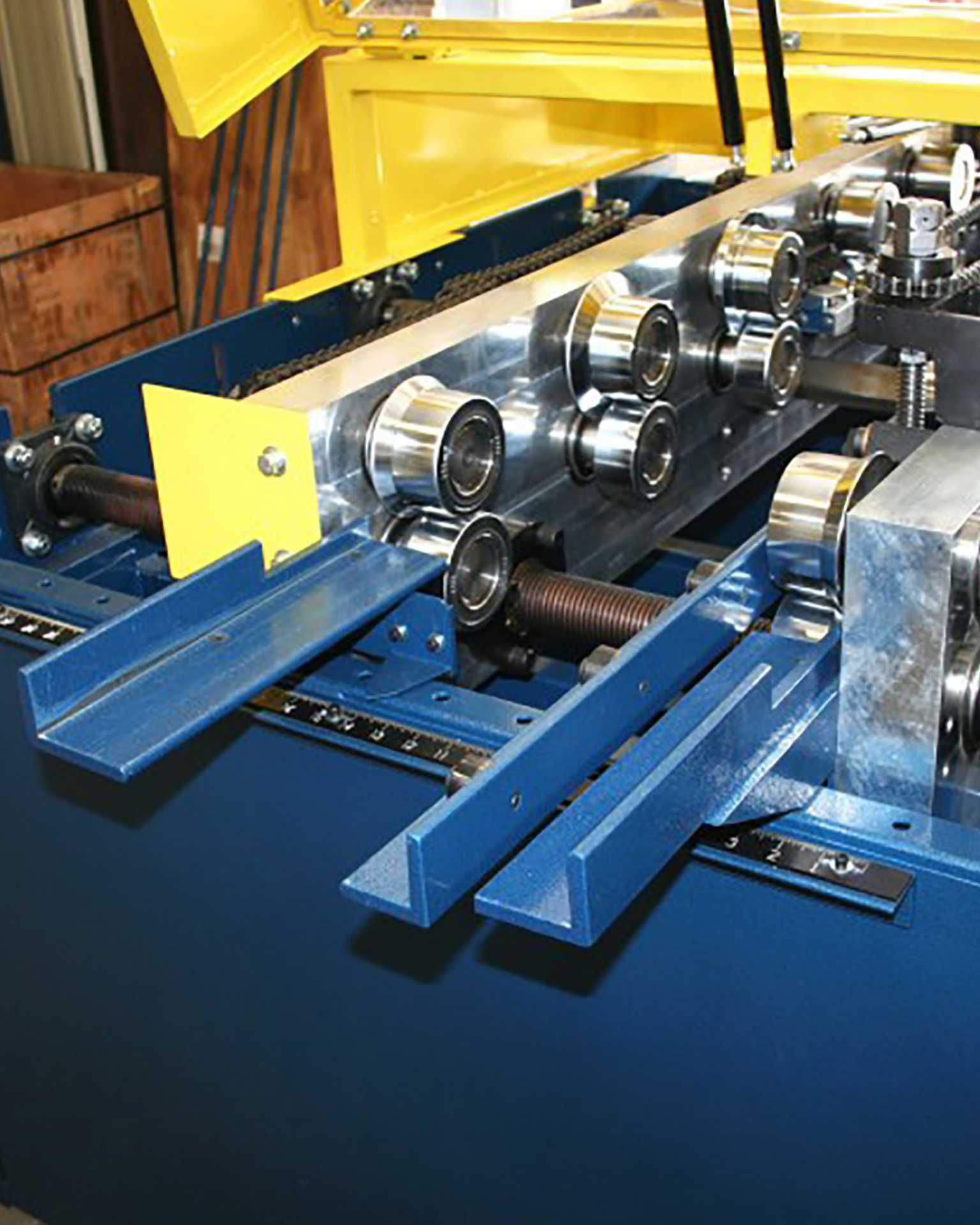
Offset Bending



Stretch Forming

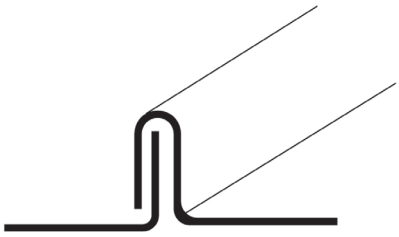
Image 22: Machine stretch forming metal (Left)

Image 23: Pressing and forming metal operations

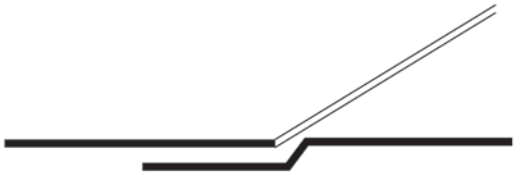


JOININGOPERATIONS

Lap Hem

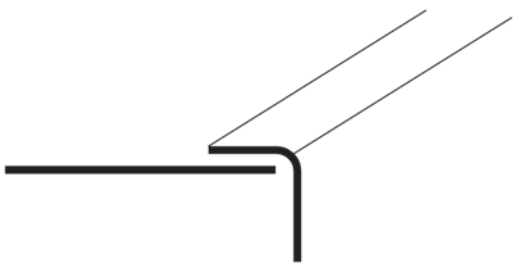


Standing Hem

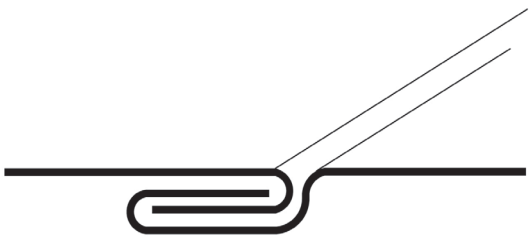


Countersunk Lap Hem

Flat Lock Hem



Outside Lap Hem



Grooved Flat Lock Hem

Image 24: Metal hemming machine (Left)

Image 25: Joining metal operations

Image 26: Current condition of former General Motors Stamping Plant

SITE REMEDIATION

In the current post industrial era, the closing of factories has created an increasing number of brownfield sites. The Environmental Protection Agency (EPA) predicts that there are more than 450,000 brownfield sites in the United States (EPA). A brownfield site per the EPA is defined as "the expansion, redevelopment, or reuse of [a site in] which may be complicated by the presences or potential presences of a hazardous substance, pollutant, or contaminate."[17] The process of redeveloping brownfield sites has several potential benefits: it reduces the need to develop "green spaces and working lands," increases the local tax base, and facilitates job growth.[18]

The location of the previous General Motors Stamping Plant is considered a brownfield site. Currently, the site is owned by the City of Wyoming Brownfield Redevelopment Authority (WBRA). RACER Trust, which was created to "conduct, manage and fund cleanup," is still responsible for subsurface contamination that has been caused by the operations done General Motors.[19] In the context of this thesis, understanding the ways site contamination and remediation can impact architectural form and organization is important. To better understand these implications, I interviewed Matthew Vander Eide, a senior project geologist at SME who was familiar with the General Motors site.[20]

Vander Eide explained that there are two major processes considered when developing a brownfield site. One procedure is to remove all the contaminants and dispose of them off site in a landfill. The other option is to leave the contaminants on the site and create a barrier. Choosing which route to go is based

Image 27: PCB-electrical equipment located in existing substations

onaseriesofconditions.Oneconsideration emphasizedbyVanderEidewasthedifferent typesofcontamination"media."Thethreemedias ofcontaminatesaresoil,groundwaterandsoil vapororgasvapor.Eachofthethesemediashave differentimplicationswhenitcomestochoosing aremediationstrategy.Otherconditionsthatare consideredinclude:thetypeofcontamination, quantityofcontamination,theimplicationsof exposure,thetypeofexposureanduseofthesite. Eachconditionisassessedtodeterminethebest solutionforaproject. [21]

17 United States Environmental Protection Agency . "Brownfield Overview and Definition." https://www.epa.gov/brownfield-overview-and-definitions
18 Ibid.
19 GHD Services Inc. "Soil Containing PCB Cleanup Completion Summary Report." 2015, 5-6.
20 Vander Eide, Matthew (Senior Project Geologist at SME). Interview with Courtney Wierzbicki. Personal Interview. Grand Rapids, February 15, 2017.
21 Ibid.

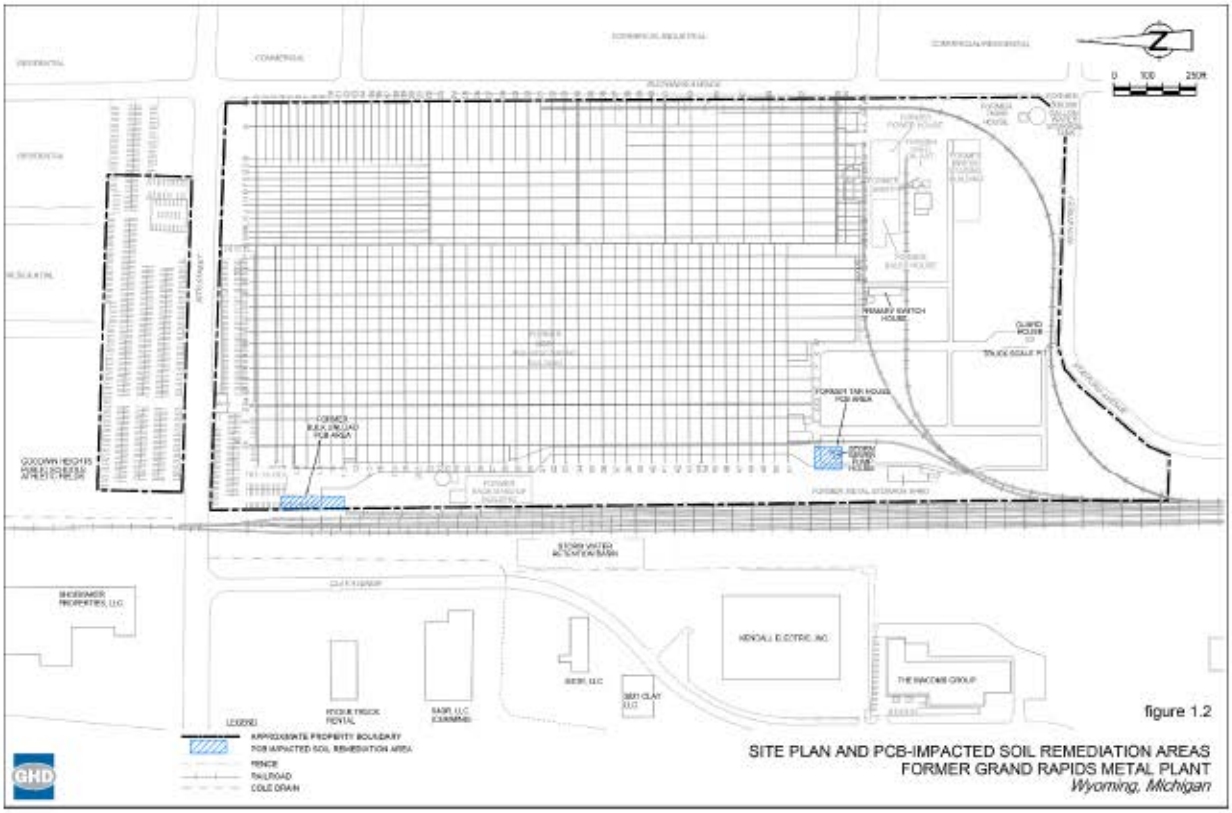


figure 1.2

SITE PLAN AND PCB-IMPACTED SOIL REMEDIATION AREAS
FORMER GRAND RAPIDS METAL PLANT
Wyoming, Michigan


ATTENTION

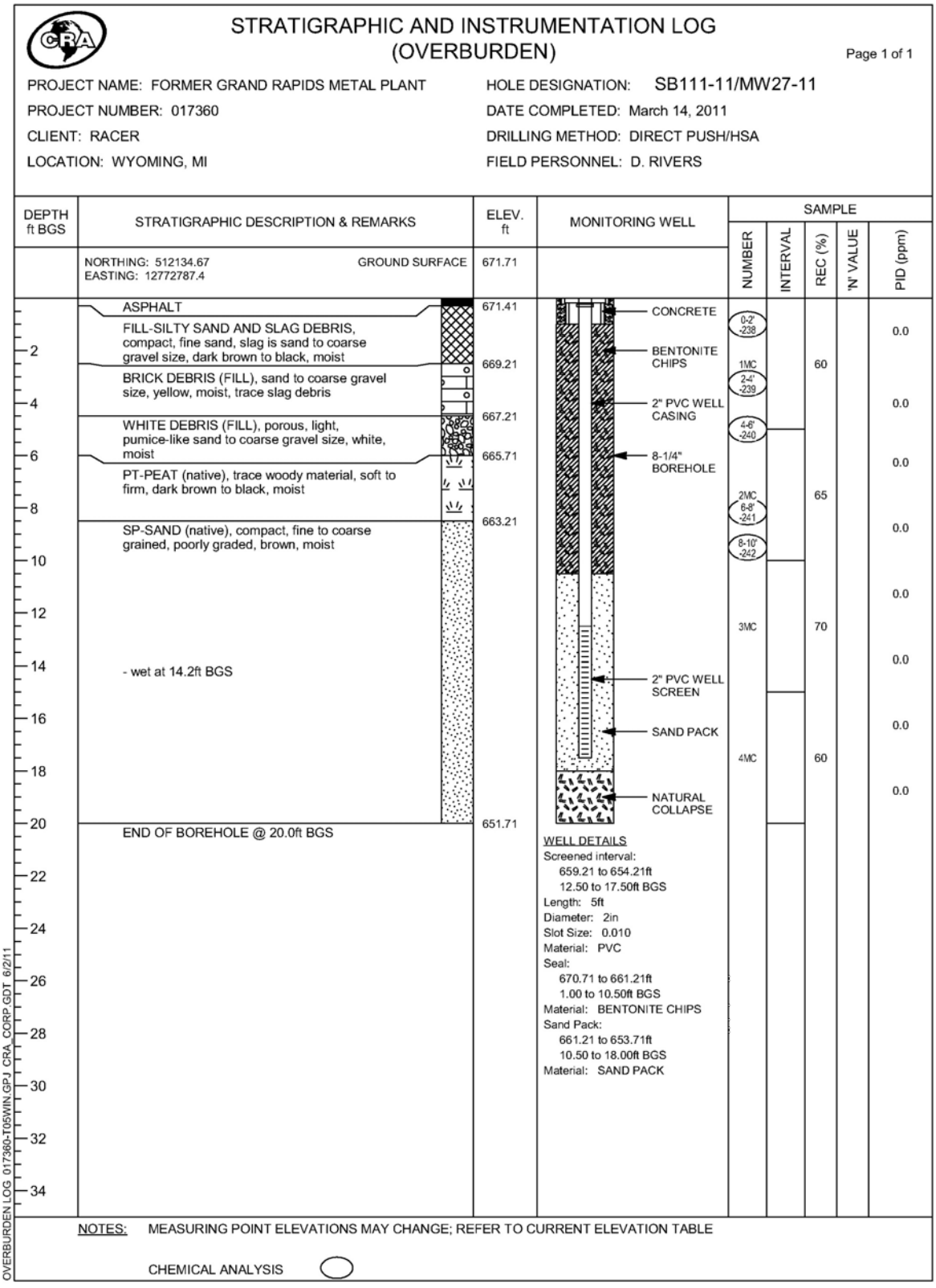


Image 30: Sample of a soil bore report showing different layers of the soil and its contents

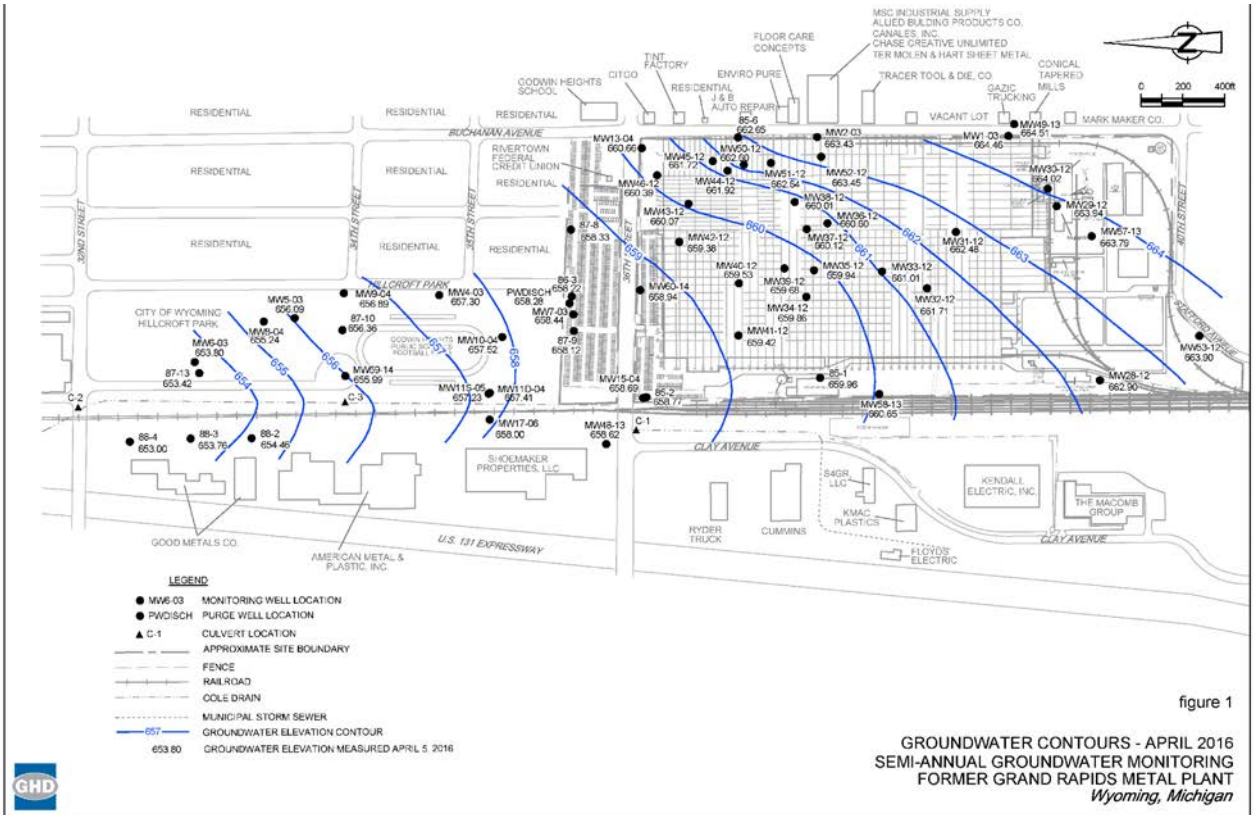


Image 31: Ground water contours April 2016

Currently,thecontaminationinthegroundwater hasminimalshorttermeffectsonthepeoplewho wouldoccupythesite.Especiallybecausethe drinkingwaterissuppliedbythecityofWyoming andthereforeundergoesregulatedtreatment beforebeingdistributed.Although,ifwellswere neededonthesitetoobtainthewatertherewould bemajorimplications.Ultimately,theremediationof thechemicalsinthegroundwaterhavefewspatial implicationsthatwouldaffecttheplacementorshape ofthearchitecturalinterventionbesidesmakingsure thecontaminatesinthewaterdonottransitioninto soilvapors.Inthiscase,vaporbarrierswouldhaveto beutilized. [27]

PHYTOREMEDIATION:

Lastly,onetypeofsiteremediationthatVander Eidedidnotmention,butcouldbeatechnique usedonthesitetoremovesoilandground watercontaminateswouldbeaprocesscalled phytoremediation.AdocumentbyToxicologicaland EnvironmentalAssociates,Inc(TEA)wascreated in2009regardingthefeasibilityofalternative greenremediationapplicationsonthesiteofthe oldGeneralMotorsStampingPlant. [28]Through this study, it was identified that phytoremediation couldbeutilizedonthesiteusingwillowsand poplartreesinadensityof100treesperacre. [29] Thissystemwouldreducecontaminatereduction through“enhancedin-situbiodegradingof contaminantsduetoconditionsinandnearthe

27 Ibid.

28 Toxicological and Environmental Associates, Inc. Feasibility Evaluation of Alternative Green Remediation Applications. 2009, 2.

29 Ibid., 6.

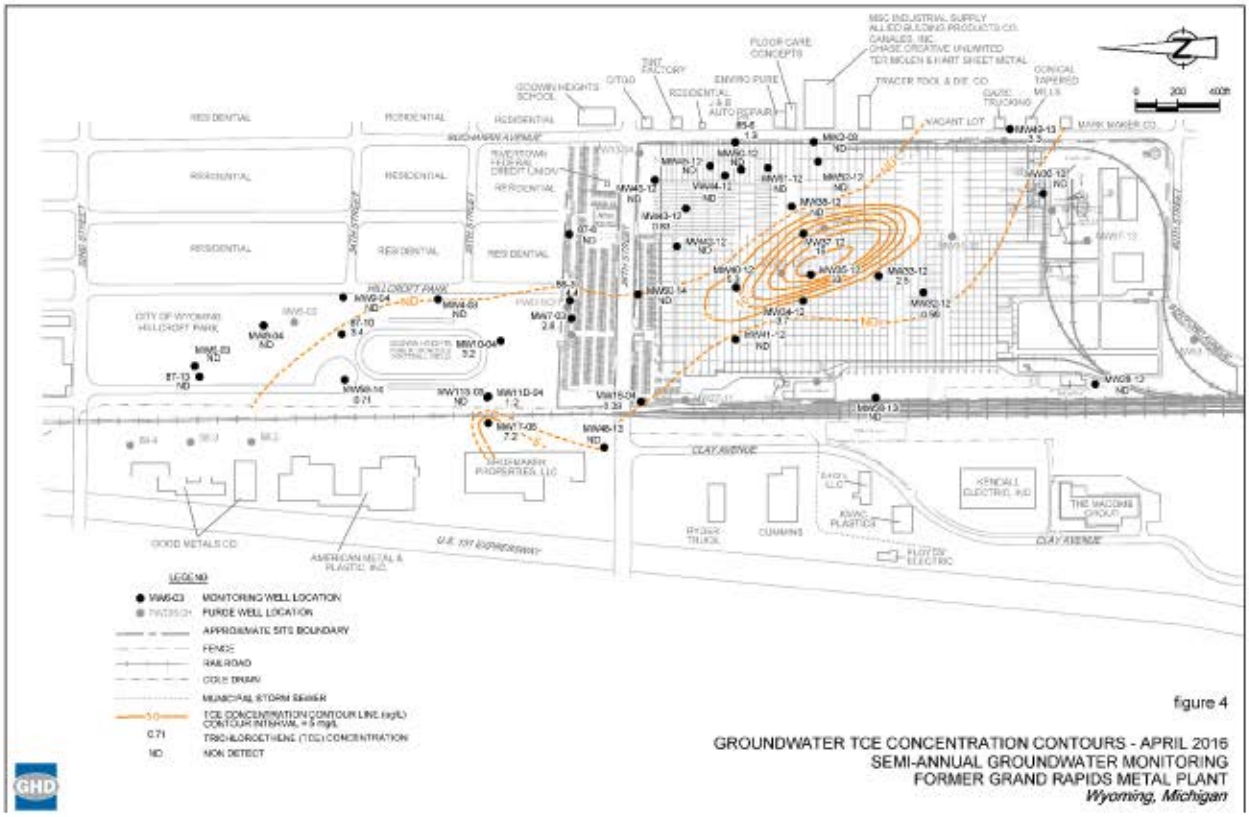


figure 4

GROUNDWATER TCE CONCENTRATION CONTOURS - APRIL 2016
SEMI-ANNUAL GROUNDWATER MONITORING
FORMER GRAND RAPIDS METAL PLANT
Wyoming, Michigan

Image 33: Consolidated areas of interest with contamination

SOCIALANDCULTURAL CONTEXT

Thisthesisengagesinsocialandculturaldiscussions abouthowpeopleliveandworkintoday's Americaninnerringsuburbs.Themajordecline inmanufacturinginthesecommunitieshasnot onlypunchedholesinthesuburbanfabric,buthas changedthesocialandculturalmakeupofthese communities.

TheAmericaneconomyisconstantlyundergoing development.Formorethanthreedecades,the economyhasgraduallybeentransitioningfroman industrialbasedeconomytoaneconomybasedon servicesandinformation. [31] Throughautomation,and theglobalizationofmanufacturingprocesses,jobs thatoncesustainedtheworkingclassintheUnited Stateshavebeentakenoverby"machinesand low-paidforeignworkers." [32] This is not the first time thattheAmericaneconomyhasbeenthoroughly transformed.Beforetheindustrialrevolution, agriculturewastheheartofeconomy,butlike manufacturingtherapidadvancementintechnology hascontributedtoagriculturemakinguponlytwo percentofallAmericanworkers. [33]Technologyhas contributedtotheeconomicchangeofthepastfew decades,butsohastheperceptionthatacollege degreeisthecomprehensiveanswertoworkingclass struggles.Aboveall,thiseconomicandsocialchange isgreatlyeffectingtheworkingclass,andleadingtoa largersocioeconomicgapbetweenrichandpoor.

Despitethelossofmanylesser-skilledmanufacturing jobs,highlyskilledworkersareindemandtoday. AnarticleintheWallStreetJournalpublishedon February2nd,2017,istitled"SkilledWorkersAre ScarceinTightLaborMarket."Yetskilledtrades andmanufacturingjobsarenolongerseenas

31 Don Peck, "Can the Middle Class Be Saved?" The Atlantic (July 24, 2011), General OneFile, 3.
32 Ibid.
33 Ibid.

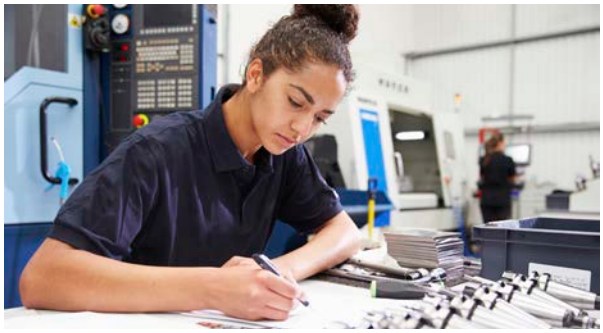


Image 34: Advanced manufacturing is more intellectually engaging then previous manufacturing techniques

desirableinourcurrentsociety.Thecurrent socialunderstandingofmanufacturingjobs isthattheycompriseofmindlessrepetitive tasks.Although,astheamountofautomation inmanufacturingfacilitiesincrease,itactuality causesjobstobecomemoreintellectually stimulating.Manufacturingtodayrequiresmore humaningenuitythaneverbeforeastechnology andprocessesadvance. [34] AccordingtoaTime MagazinearticlebySujeetChandandJimDavis, "tenyearsfromnow,theglobalmanufacturing sectorwilllooknothinglikeitdoestodayas AdvancedManufacturingwillhaverapidlychanged itslandscape." [35]

Oneofthebiggestchallengesoursocietyfaces asweenterthetechnologicaleraiscreating awarenessandtheincreaseddesireforyoung adultstopursueacareerinarapidlychanging industry.[36] Throughthisthesis,therelationship betweenlivingandworkingwillbereimagined tobetterservethefutureoftheworkingclass, createagreaterunderstandingofthechanges inmanufacturingjobs,andcreateadesirefor theyoungadultstoconsidermanufacturingasa valuedcareer.

Thechangingeconomyandthedeclineinthe manufacturingindustryhasalsochangedthe

34 Sujeet Chand, and Jim Davis, "What is Smart Manufacturing?" Time Magazine, n.d.
35 Ibid.
36 Don Peck, "Can the Middle Class Be Saved?" 9.

waypeoplelive,especiallyintheinnerring suburbs.Theexistingsuburbantypologyisbased on working class families who resided in fifteen hundredsquarefootbungalowsandworkatthe factorydownthestreet.Although,whatwasan essentialpartofthe“Americandream”isnow fragmentedbecausetheidealsofourcultureand societyhavechanged.Theidealshaveshifted fromtheempoweredhomeowningworkingclass ofmid-twentiethcenturyAmericatotheinsecure workingclassofthesuburbsleftbehindby manufacturing. The working class as defined by Marxisttheoryarethosewhohavenocapitaland onlyhavethemeansoftheirlabortosurvive. [37] Previously,workingclassAmericanfamiliessought outhomeownershipinthesuburbsasasourceof economicprotectionagainstunemployment,illness oroldage. [38]

Asnationalhomeownershipcontinuestodecline, thesingle-familyhomeasapartofthe“American dream”becomeslessrelevantintoday’sinner ringsuburbs.Thedeclineofindustryinthepost-industrialeraprovesthathomeownershipcannot providefullsecuritytotheworkingclassagainst unemployment.Forexample,aftertheclosing oftheGeneralMotorsplantinGodwinHeights, familiesnotonlylosttheirjobs,butalsotheir homes. Agrowingdemographicchangefromall whitecommunitiestomulticulturalcommunities hasplayedaroleinthediminishingdesireto liveinsinglefamilyhomes.Thewhite-dominated homeownershipculturethatGodwinHeights representedinthepostwarperiodhasgivenway toamorediverseculturethatislessfocused onownership.The“AmericanDream”thatwas presentedinthemidtwentiethcenturyisnolonger whatfamiliesdreamoftoday. [39]Inthecontextof

37 Friedrich Engels, Principles Of Communism (Engel’s Original Draft of the Communist Manifesto), Chicago: Workers Party of America by the Daily Worker Pub. Co., 1925.

38 Richard Harris, “Working-Class Home Ownership in the American Metropolis,” Journal of Urban History 17, no. 1 (November 1990): 47.

39 Emily Badger, “Where the ‘American dream’ of homeownership is fading the most,” The Washington Post, February 16, 2016.

Image 35: University of Detroit Mercy College of Engineering & Sciences engaging in the Society of Manufacturing Engineers

Image 36: Godwin Heights Single Family Home

housing,thisthesiswillreevaluatethesocialand culturalnormsofthe“Americandream,”inworking classinnerringsuburbs.TheclassicAmerican bungalow is no longer fitting for the multitude of ages, familytypologies,culturesandethnicitiesinwhich nowresideinthesesareas.

Ultimately,thewayweliveandworkeffectshow our culture or society is perceived or defined. The existingmodelofmanufacturingandhousinginthe innerringsuburbsnolongersupportsthecurrent diversevaluesofAmericansociety.Thisarchitectural thesiswillproposeasolutionthatismoreresponsive tocontemporarysociety'sneedsanddesiresfor livingandworkingininnerringsuburbs,andthereby supportingpositivesocialandculturalchanges.

Their final proposals were displayed at the MuseumofModernArt(MOMA)inanexhibition titled“Foreclosed:RehousingtheAmerican Dream.”[43]EachfocusedonadifferentAmerican suburb.Eachsolutionpushedtheboundaries ofarchetypalsolutionsinhopesofchanging thetrajectoryoftheAmericansuburbsthatare sufferingduetheforeclosurecrisis.

In the same way as the five architects from the Foreclosedexhibitreimaginedthepatternsof living,working,andhomeownership.Thisthesis willusethedisciplineofarchitecturetoreevaluate therelationshipbetweenindustrialworkand housing,andchangethe“Americandream”of postindustrialinnerringsuburbs.

Oneprojectfrom“Foreclosedthatthisthesiscan closelyrelatetoisStudioGang’ssubmission titled“TheGardeninTheMachine.”Muchlike thisthesis,StudioGang’sprojectresidesinan innerringsuburbthatisexperiencingsocialand cultural change due the flight of industry in the suburbs.Throughthedesignprocess,Studio Gangreimagedtheneighborhood’snarrative.By reframingtheproblem,thenarrativechangedfrom livingintightlypackedbungalowstoaproposal thatisbasedonalimitedequitycooperative. [44]

LiketheBuellHypothesis,D'HoogheandHauke's “AfterPostmodernism:ReaddressingtheRoleof UtopiainUrbanDesignandPlanning,"discusses howpolitics,economicsandsocialchanges havecreatedopportunitiesfornewurbanideas. D’HoogheandHaukeareunabletoinstigatemajor changetoproblematicurbanconditions.They suggestthatbyrediscoveringutopia,architects, plannersanddesignershavethepotentialto

Image 39: *Foreclosed:RehousingtheAmericanDreamMoMA Exhibit*

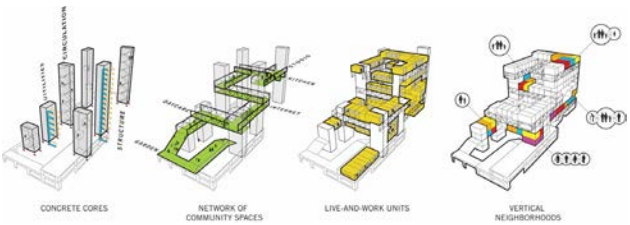


Image 40: *TheGardenintheMachineConceptDiagram*

Image 41: *TheGardenintheMachineRendering*

43 Museum of Modern Art, “Foreclosed: Rehousing the American Dream,” https://www.moma.org/interactives/exhibitions/2012/foreclosed/.
44 Ibid.


No
Trespassing
Private
Property

Image 43: Aerial photograph of General Motors Stamping Plant 1930/40's

NEIGHBORHOOD

CITYOFWYOMING NEIGHBORHOODS

LocatedsouthofdowntownGrandRapids,thecityof WyomingandtheneighborhoodofGodwinHeights flourishes on a strong manufacturing economy that hasshapedwhatitistoday.Themaptotheright depicts the neighborhood boundaries as defined bytheCityofWyomingandtheschooldistrict boundaries as defined by Godwin Heights Public Schools.

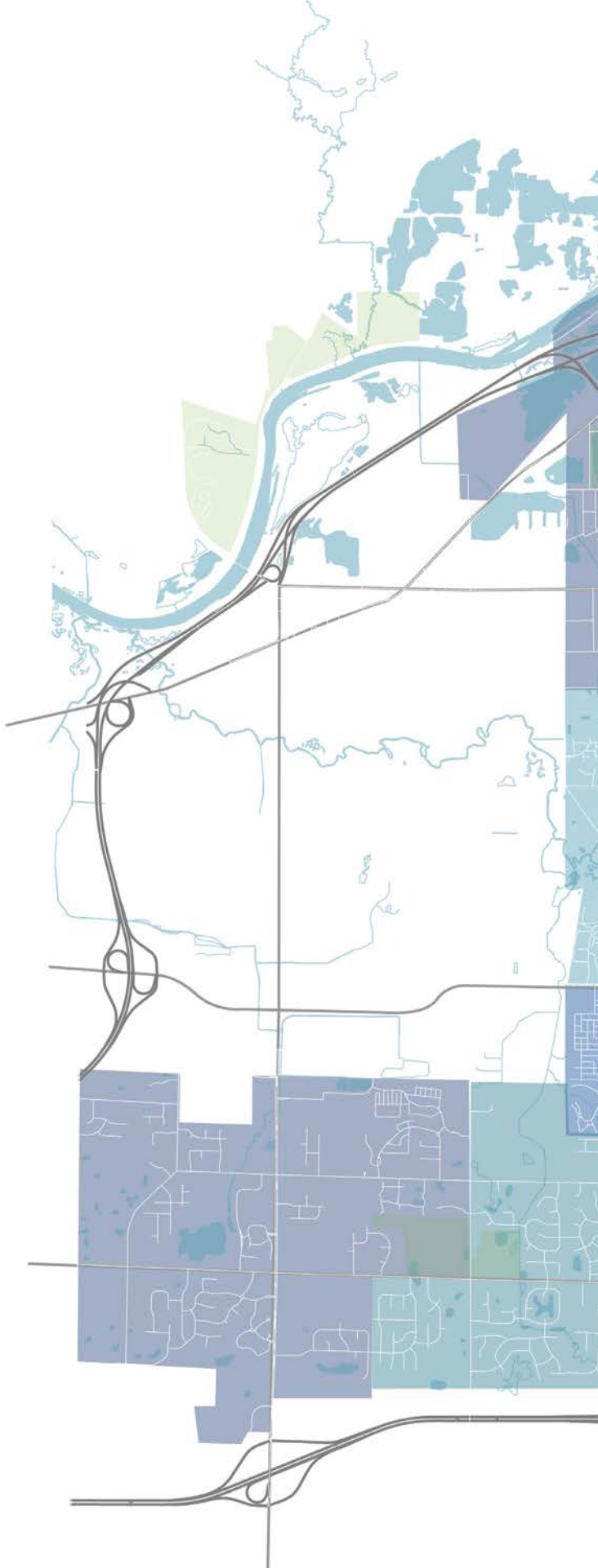
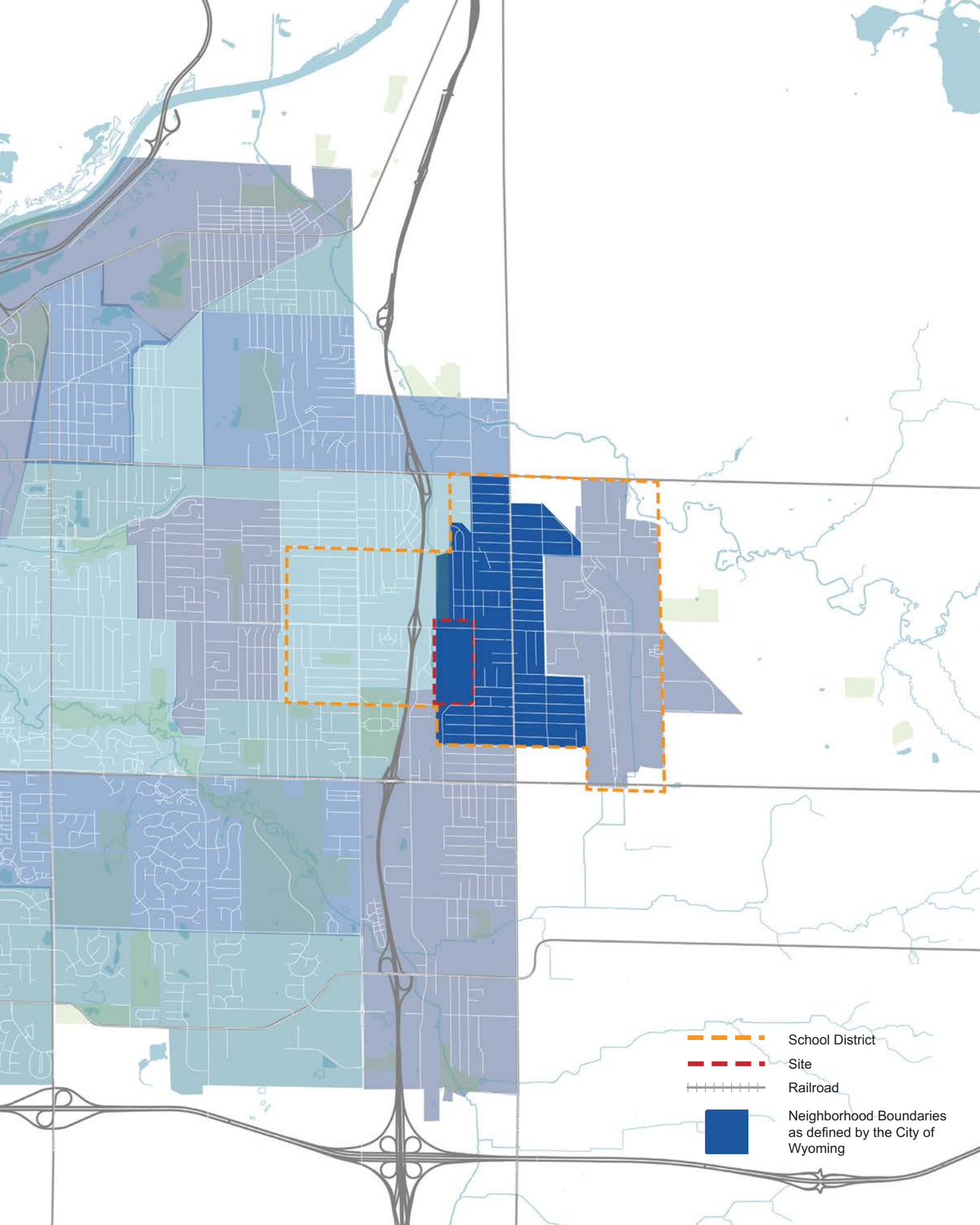
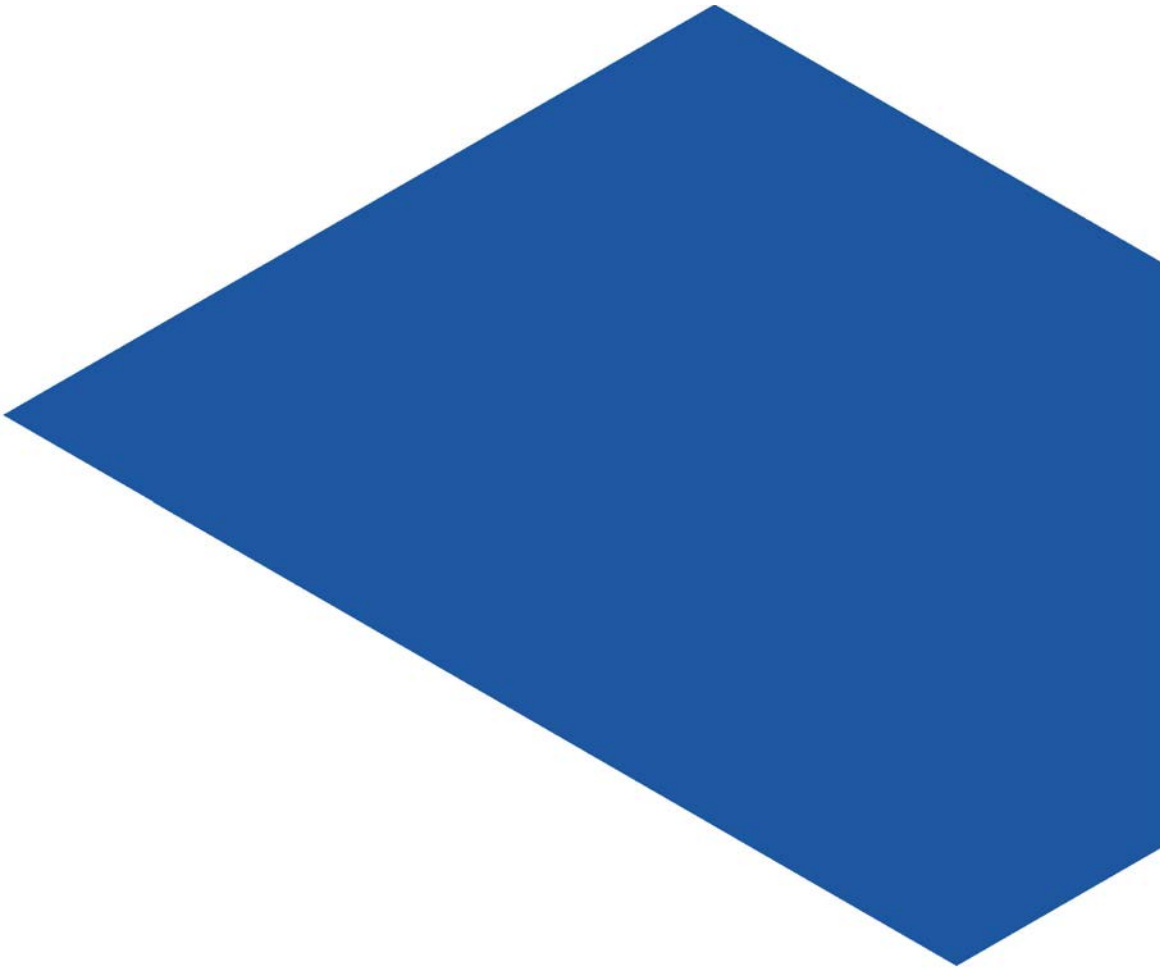


Image 44: Wyoming neighborhood boundaries

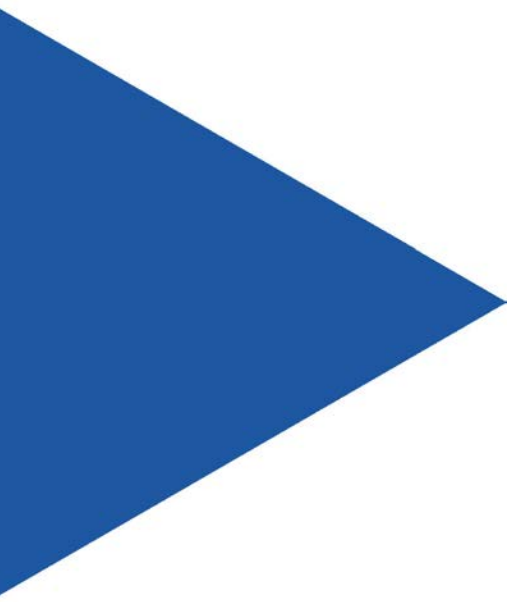

School District
Site
Railroad
Neighborhood Boundaries as defined by the City of Wyoming

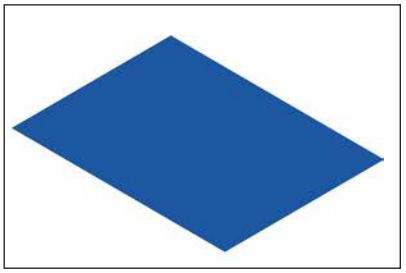


OPERATORS ON SUBURBAN FABRIC SHAPING GODWIN HEIGHTS:

CONTINUOUSFABRIC

Beforethelandthatisnowconsideredtheinnerring suburbswasdeveloped,itwasavastcontinuous fabric.





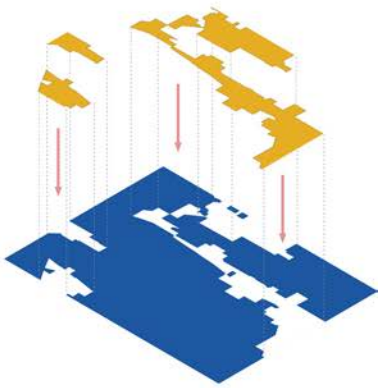
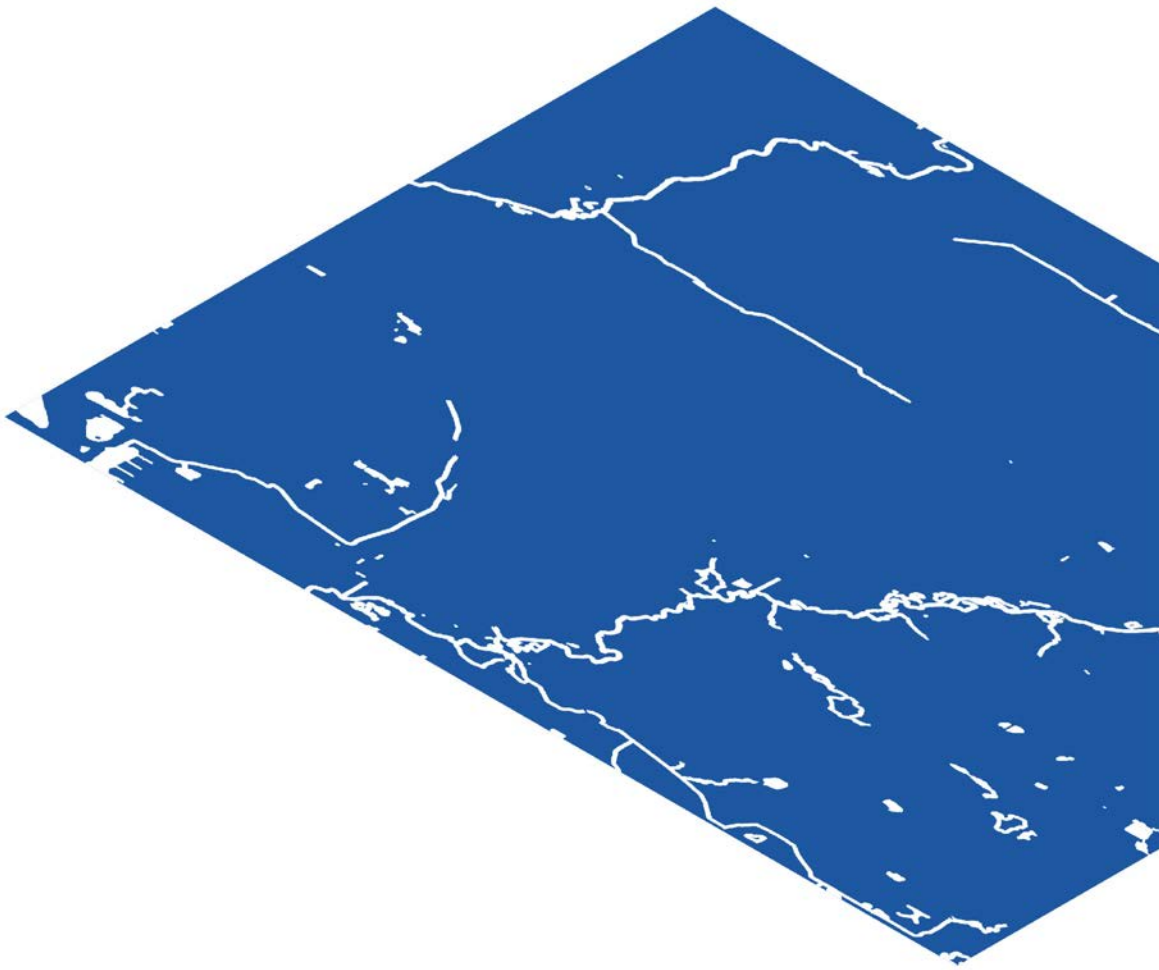


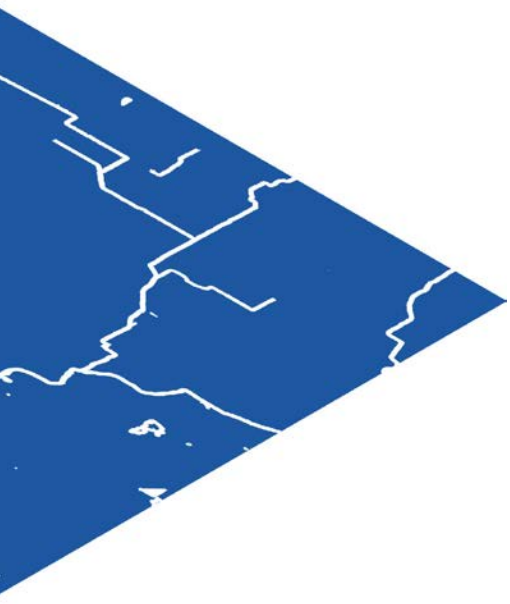
Image 45: Godwin Heights continuous fabric diagram



OPERATORS ON SUBURBAN FABRIC SHAPING GODWIN HEIGHTS:

NATURALOPERATORS

Thenaturaloperatorssuchasriversandlakesbegin tocutthroughthefabric.Thiscreatesnaturalbarriers intheoncecontinuousfabric.



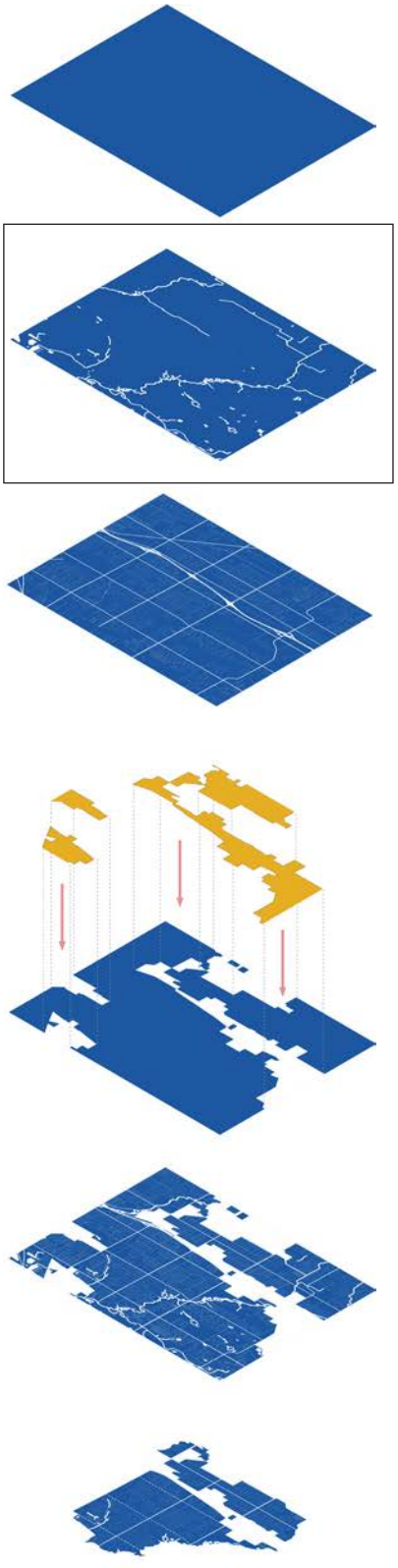
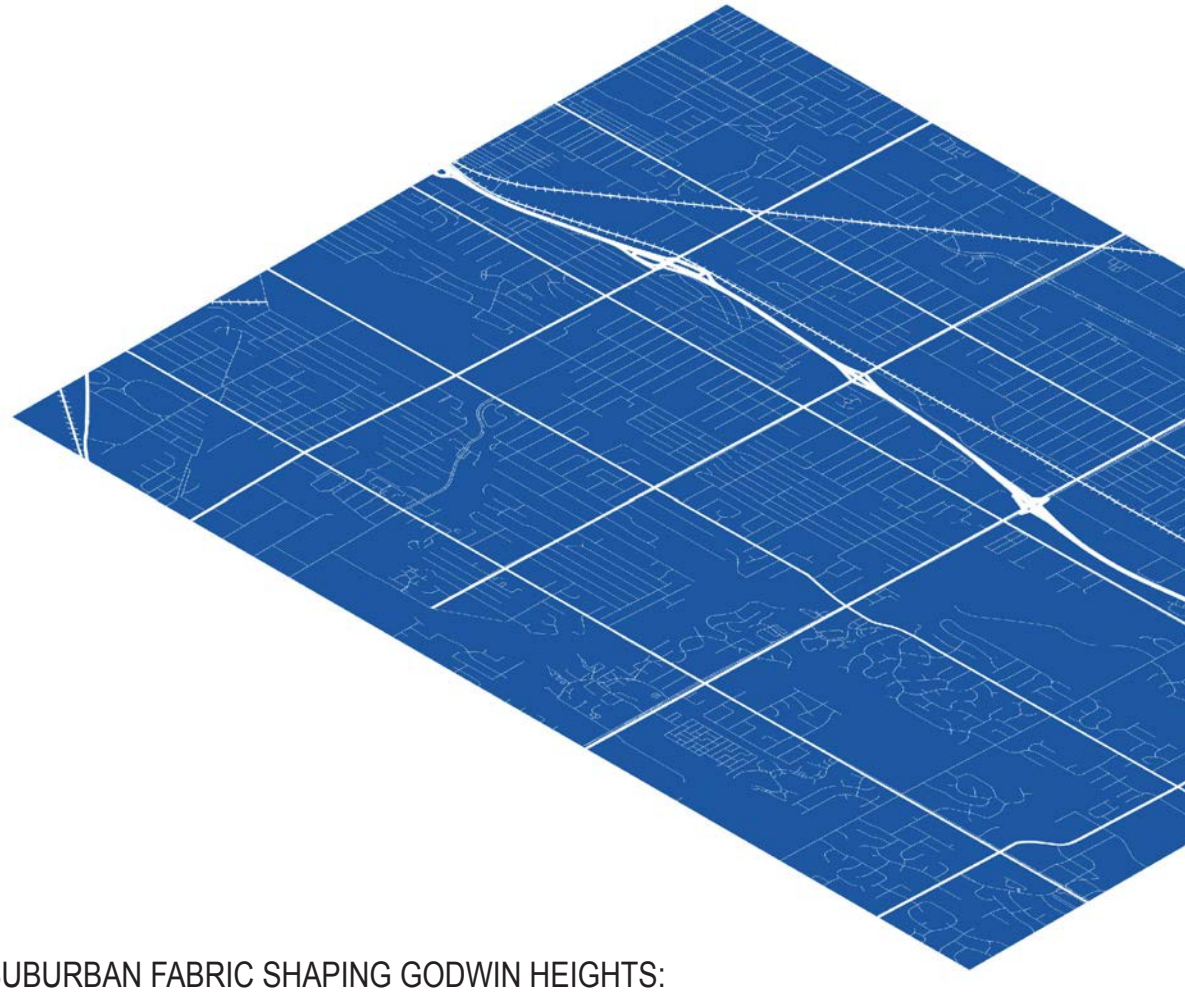


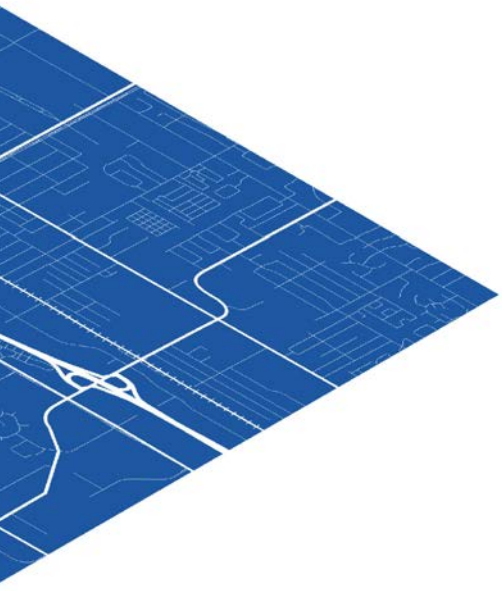
Image 46: Godwin Heights natural operators diagram



OPERATORS ON SUBURBAN FABRIC SHAPING GODWIN HEIGHTS:

INFRASTRUCTUREOPERATORS

Afterthenaturaloperatorscutthroughthefabric, humansbegantoaddinfrastructuresuchas railroads,streetsandhighways.Theseoperators continuetocutapartthefabricandcreategreater boundarieswithintheneighborhood.



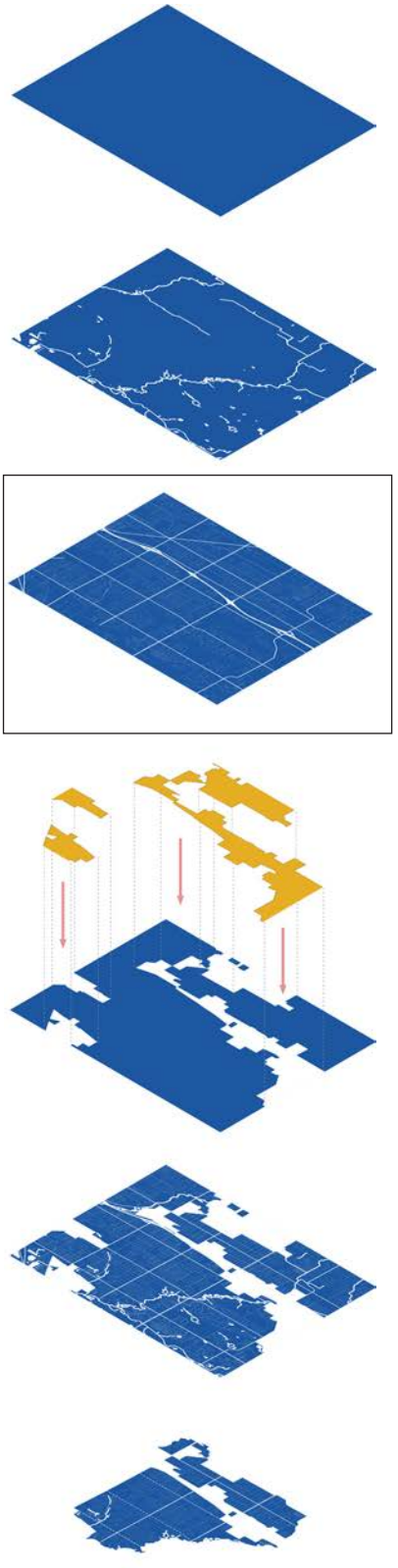
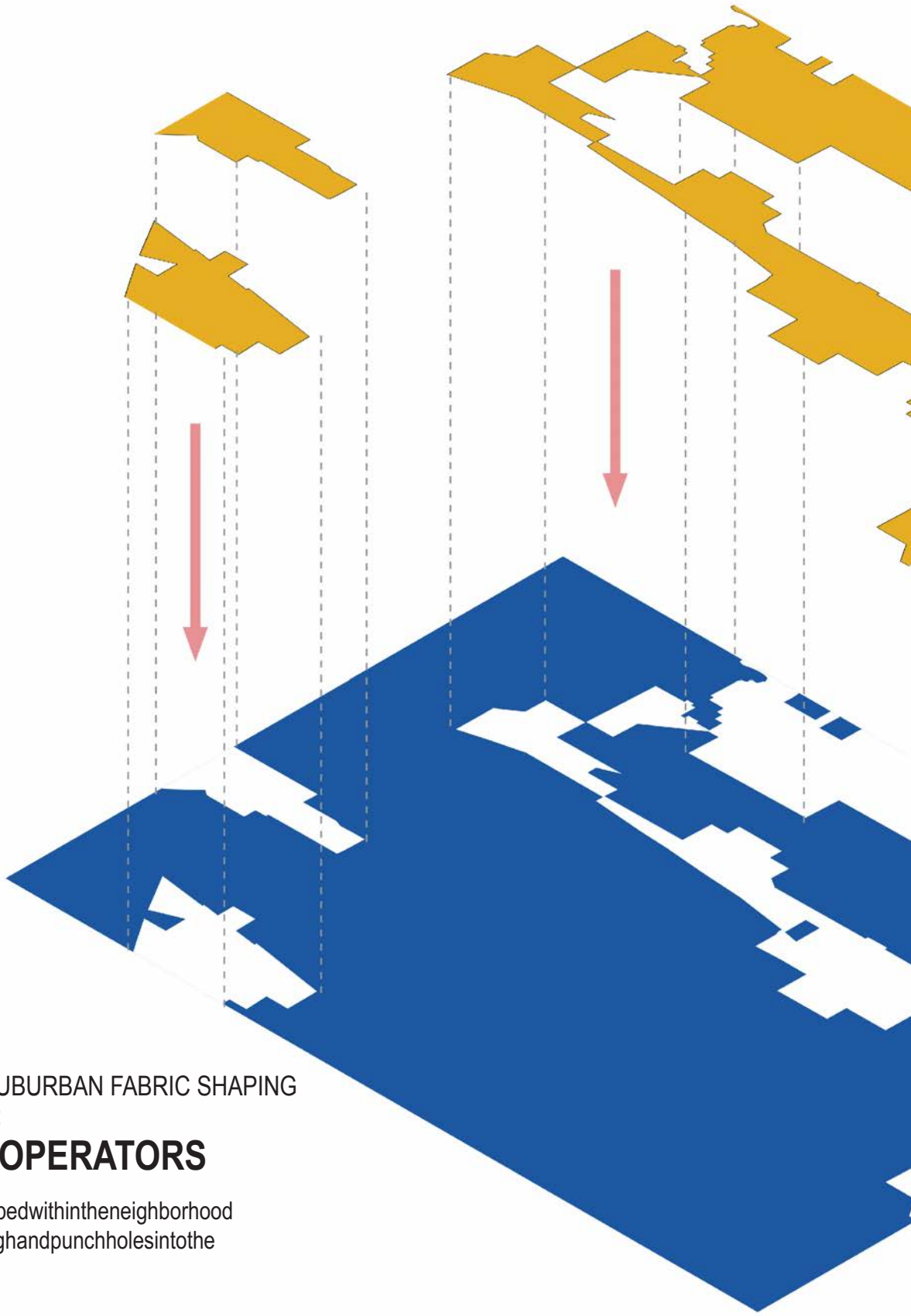


Image 47: Godwin Heights infrastructure operators diagram



OPERATORS ON SUBURBAN FABRIC SHAPING GODWIN HEIGHTS:

INDUSTRIALOPERATORS

Thenasindustrydevelopedwithintheneighborhood italsobeginstocutthroughandpunchholesintothe neighborhoodfabric.

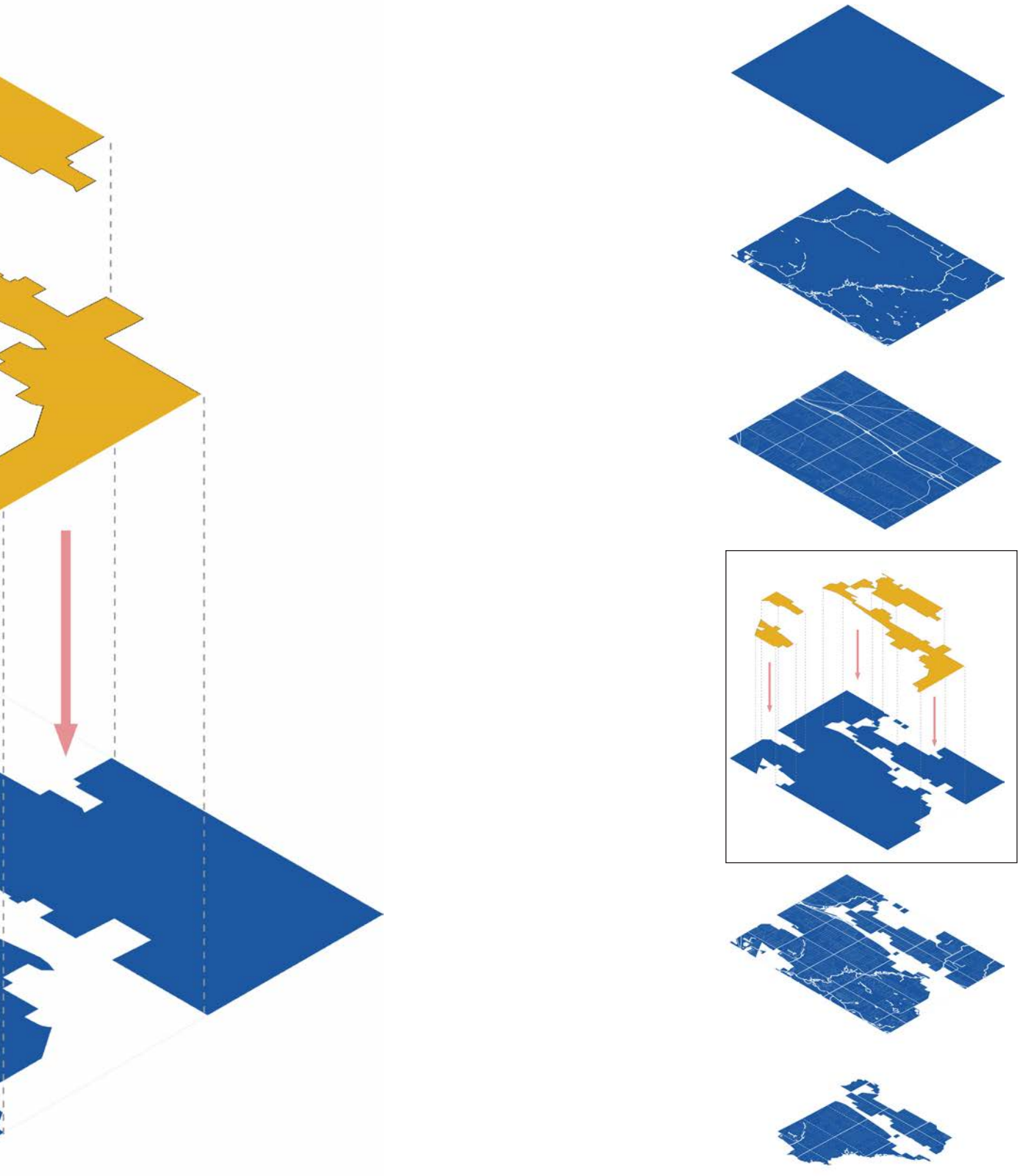
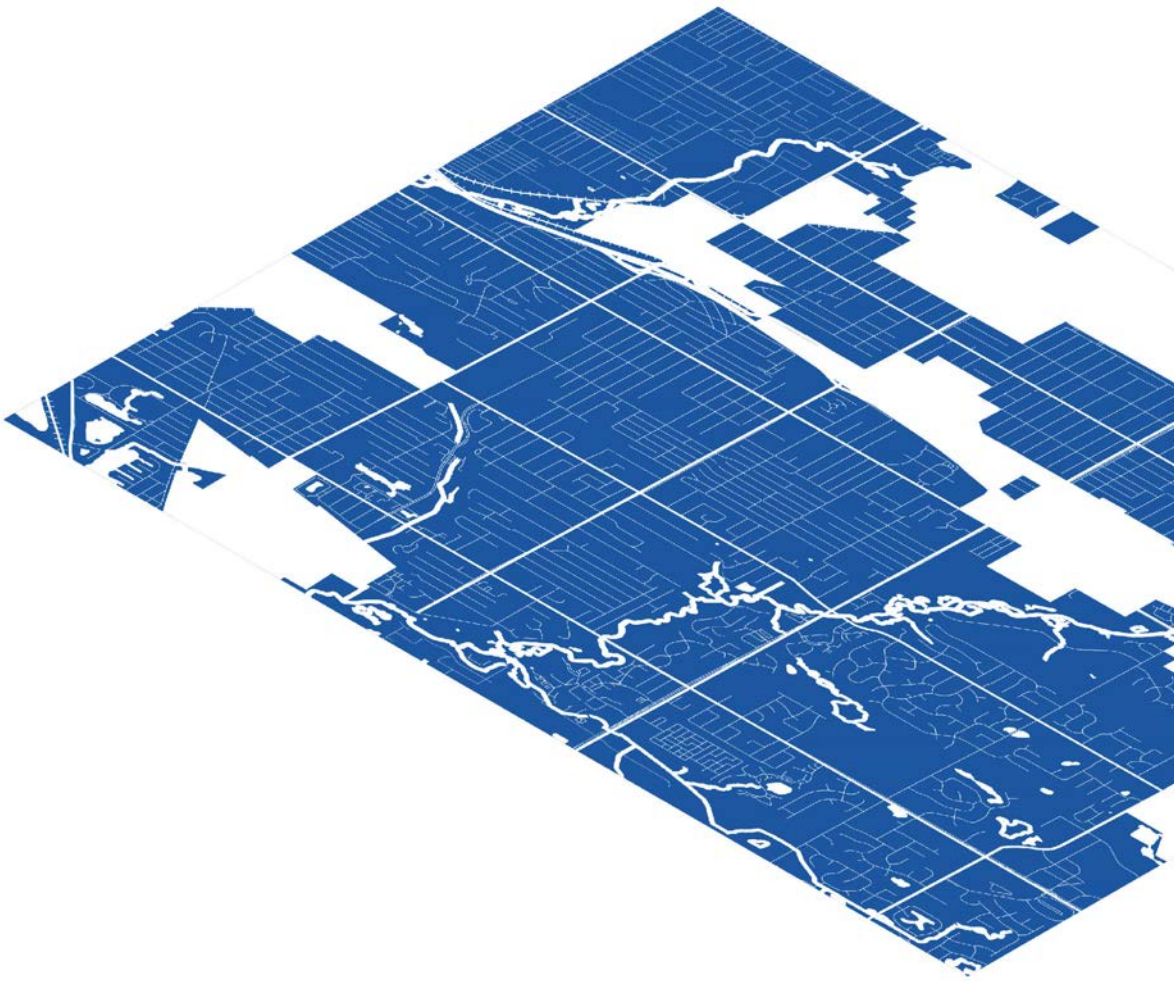


Image 48: Godwin Heights industrial operators diagram



OPERATORS ON SUBURBAN FABRIC SHAPING GODWIN HEIGHTS:

ALLOPERATORS

Whenalltheoperatorsareoperatingatthesame time,theoncecontinuousfabricisseverely disjointed.

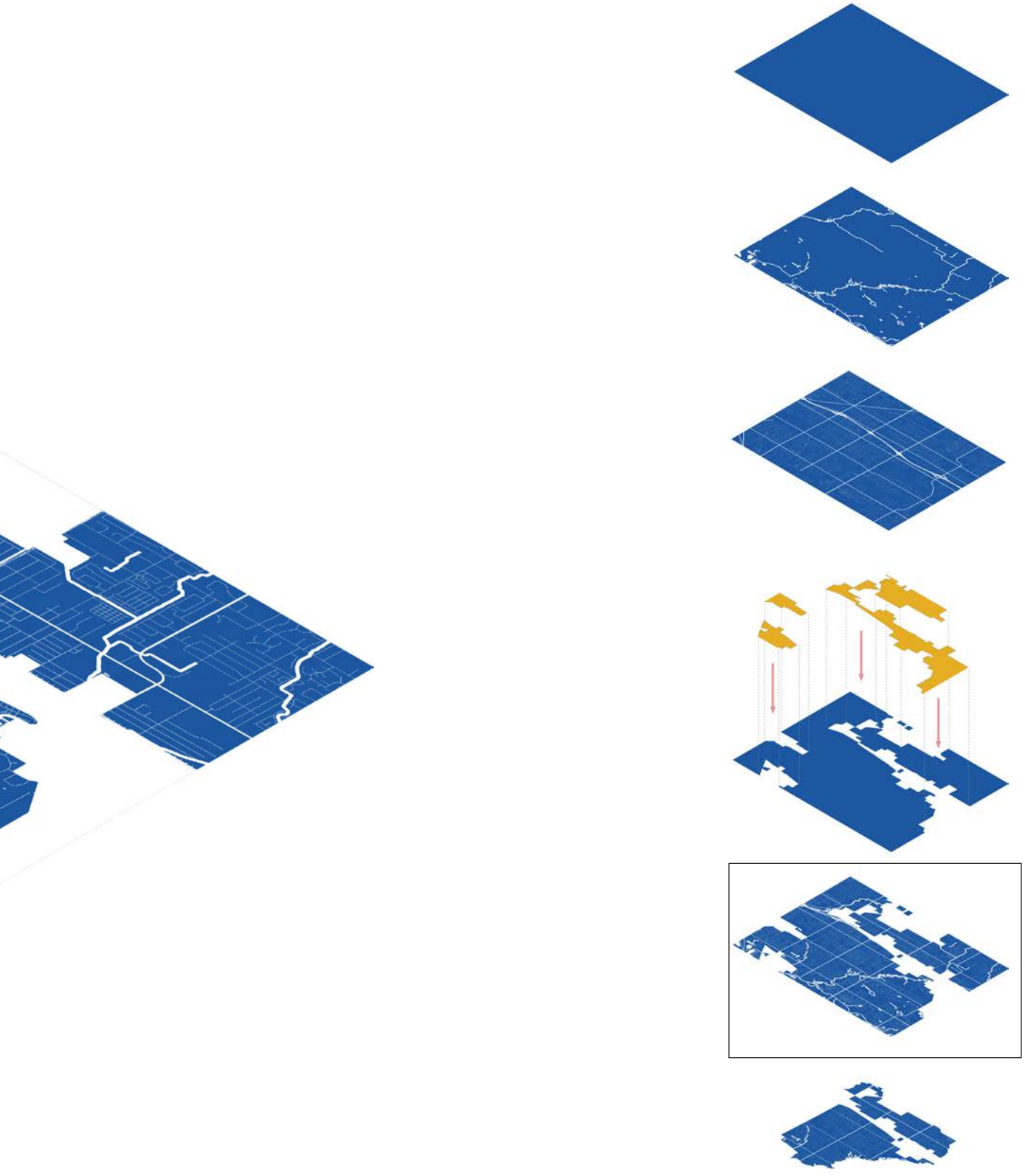
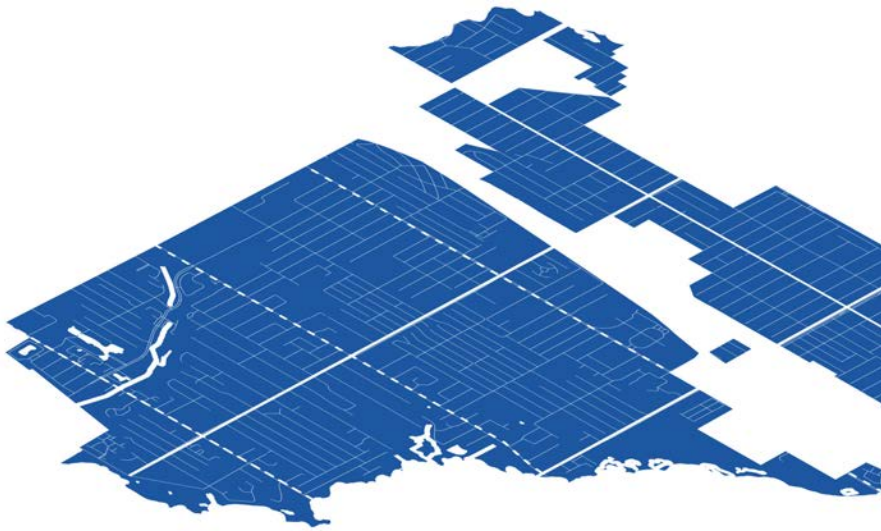


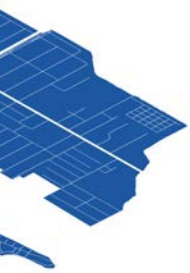
Image 49: Godwin Heights all operators diagram



OPERATORS ON SUBURBAN FABRIC SHAPING GODWIN HEIGHTS:

RESULTINGNEIGHBORHOODFABRIC

Afterevaluatingtheoperatorsonthefabric, the shape of the neighborhood as defined by theboundariesoftheoperatorsbeginstotake shape.Thisneighborhoodshapeisusedinthe followingneighborhoodneedsanalysisasa wayofevaluatingseparationandboundaries betweenimportantresourcesinthegreater GodwinHeightsneighborhood.



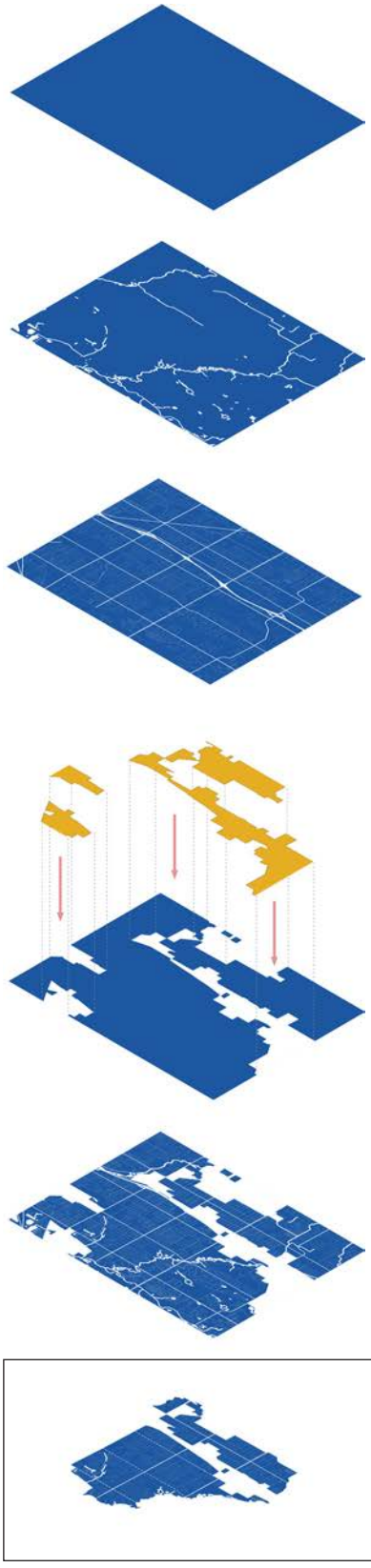
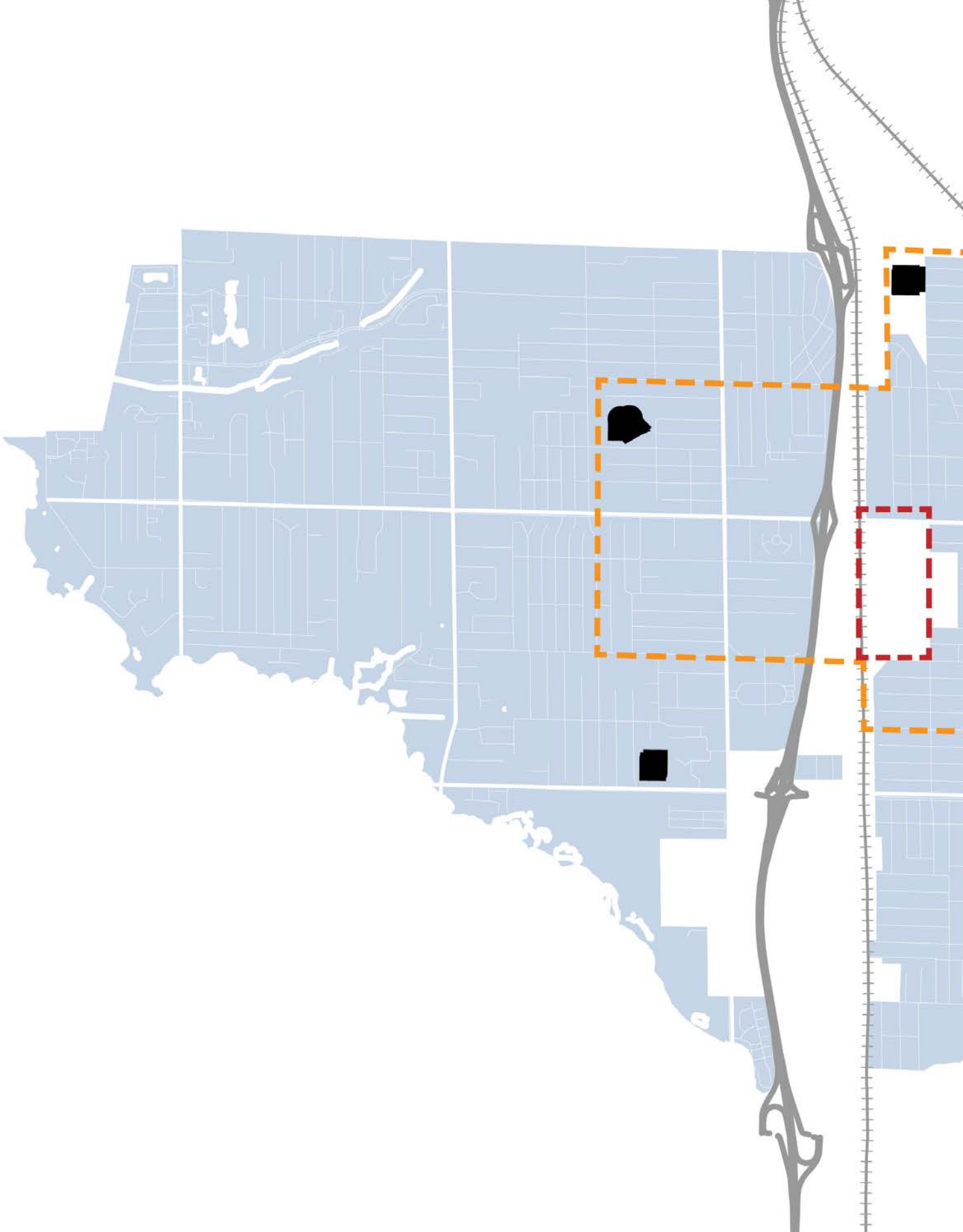


Image 50: Godwin Heights resulting neighborhood fabric diagram



COMMUNITYCENTERS

After defining the neighborhood boundaries by theoperatorsthatshapedit,theneedsofthe communitycanbebetterassessed.Whenevaluating theproximityofthecommunitycentersinthe neighborhoodinrelationtotheboundaries,itappears thatthecommunitycentersareinlocationsthatare noteasilyaccessedbythosewhomayresideonthe site.

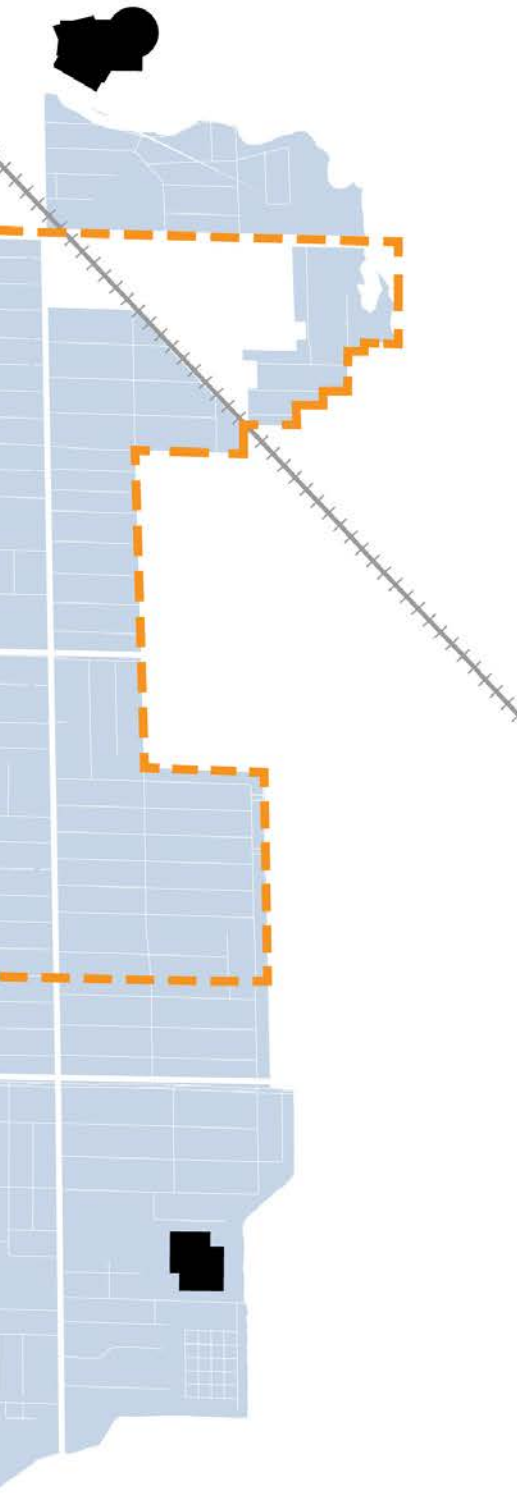
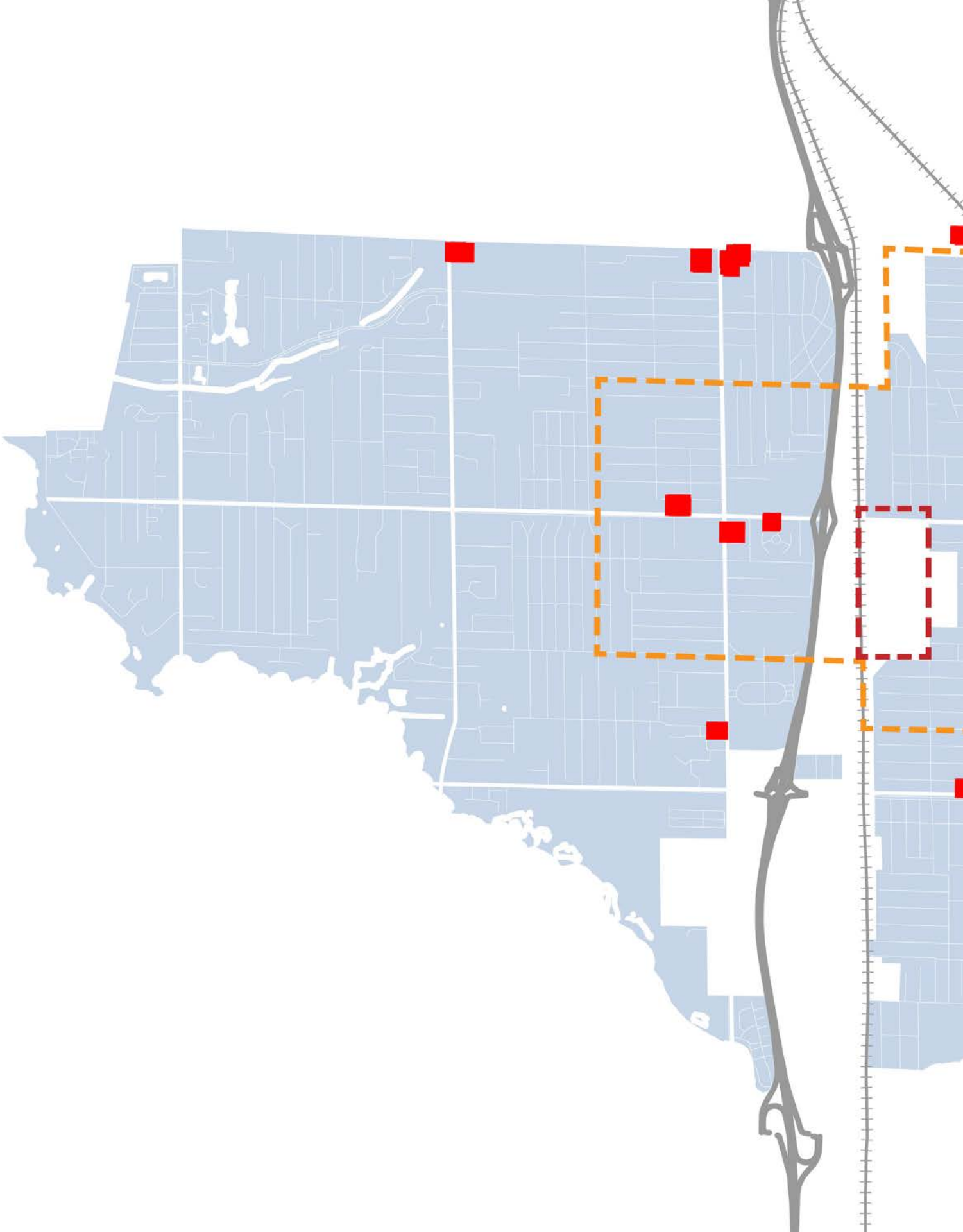


Image 51: Godwin Heights community center diagram



FOOD+GROCERY

Inrelationshiptotheboundariesthereisaccessto foodintheneighborhoodalongthebusinesscorridor ofDivisionAvenueSouth.

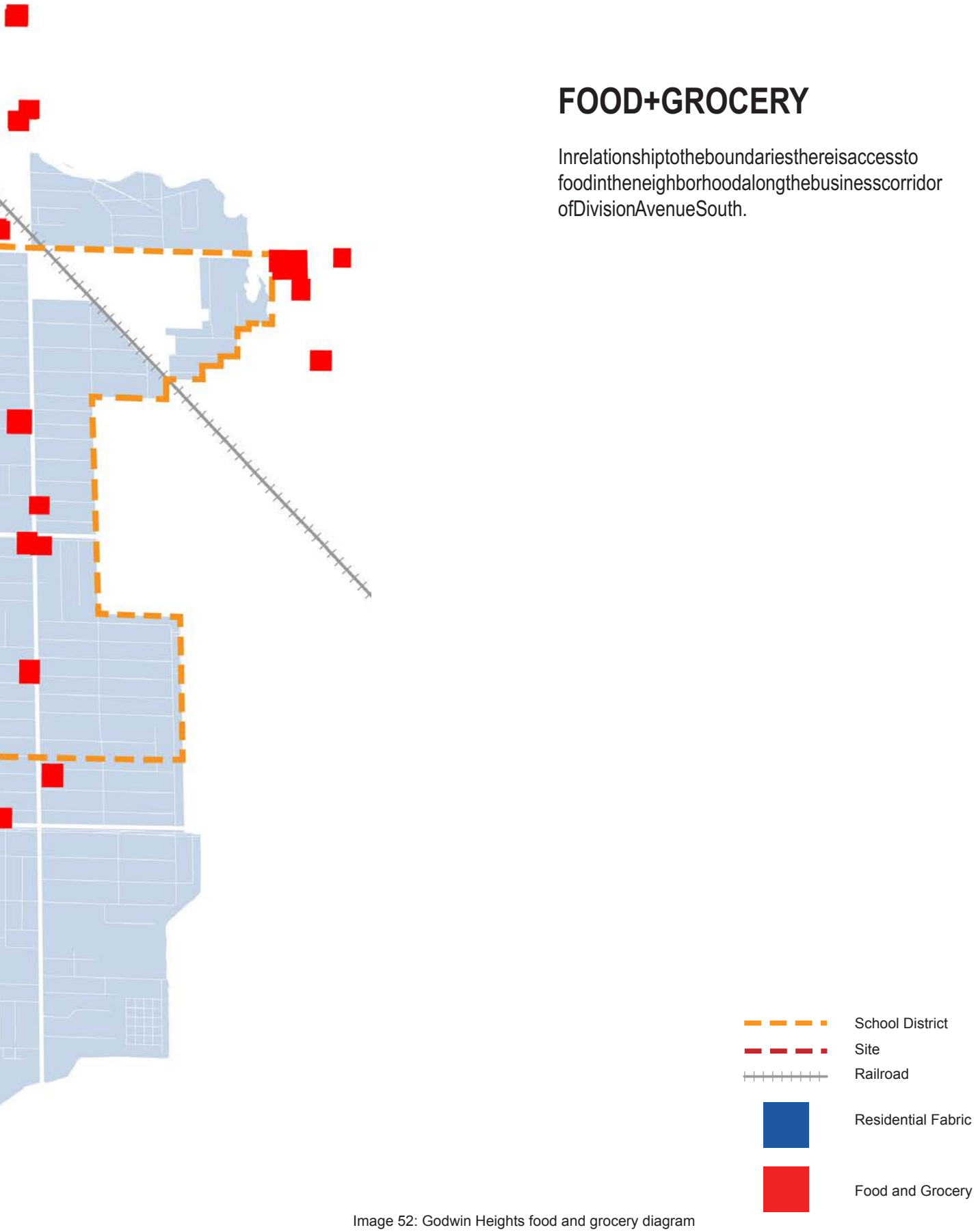
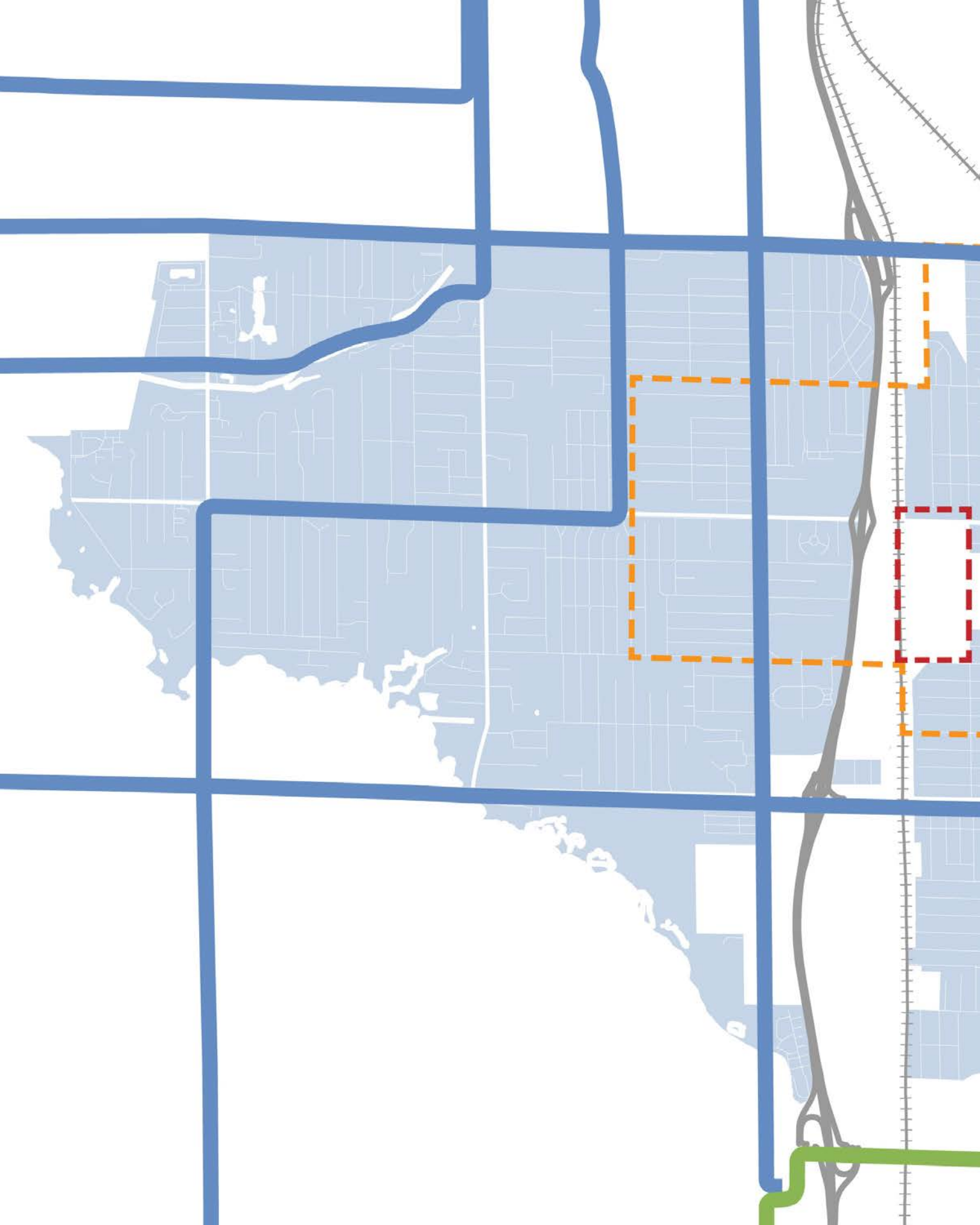


Image 52: Godwin Heights food and grocery diagram



TRANSIT

Thereisaccesstotransitlinesfromthesitealongthe DivisionAvenueSouthcorridorandtheClydePark corridor.Although,theClydeParkcorridorismore difficult to access due to the boundary created by the highway.

Image 53: Godwin Heights transit diagram

OPENSPACE

OpenspacewithintheheartoftheGodwinHeights neighborhoodissparsebesidesHillcroftParkthat isnorthofthesite.Otherparksarehardtoaccess duetotheboundariescreatedbyindustryand infrastructure.

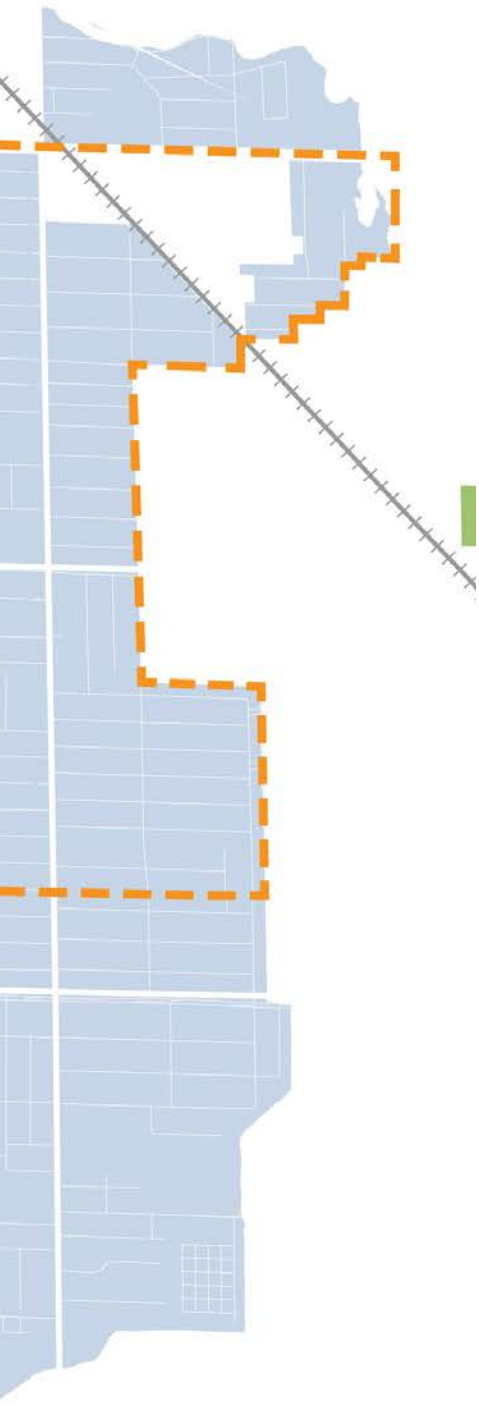
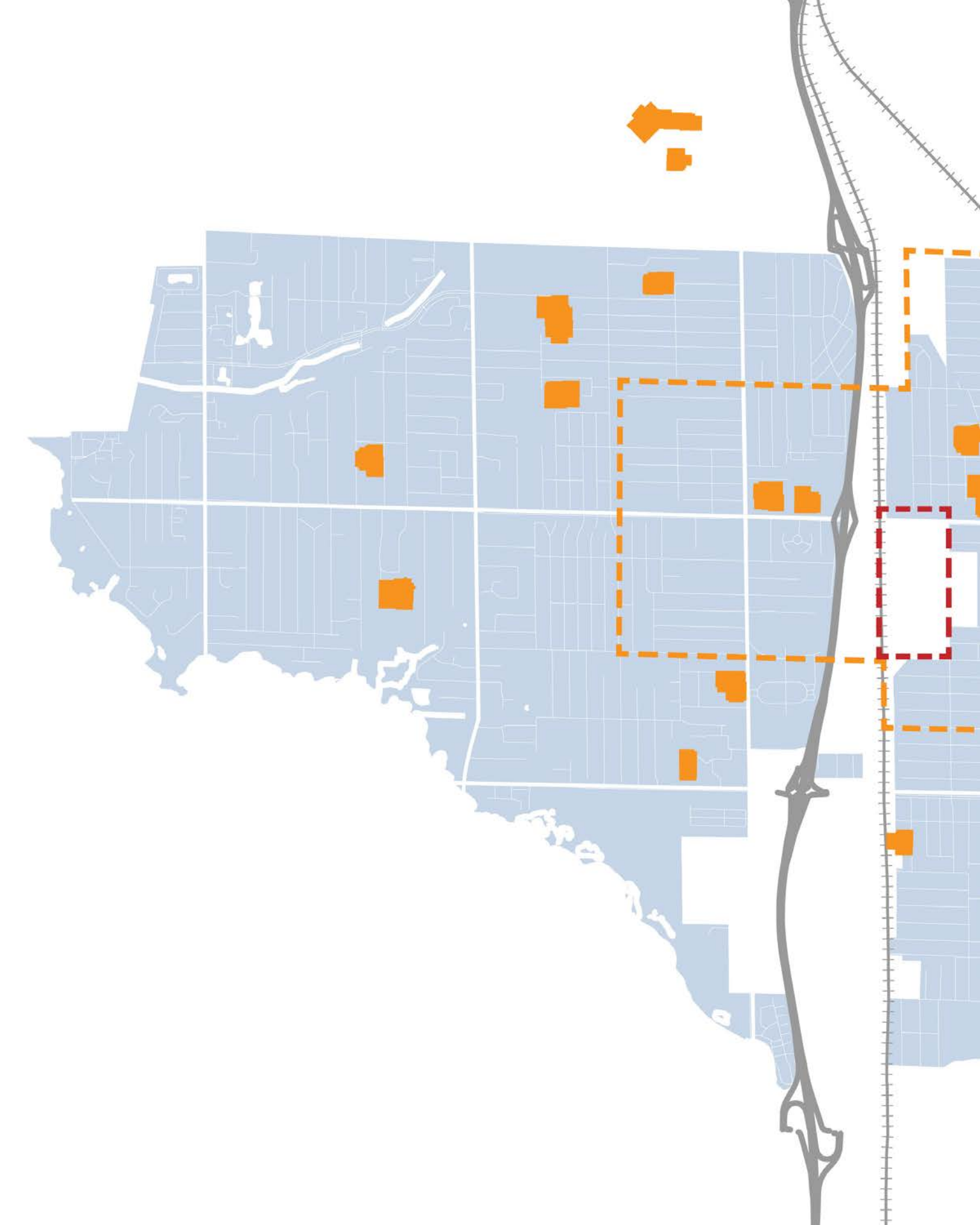


Image 54: Godwin Heights open space diagram



SCHOOLS

GodwinHeightshasagreatschooldistrictwitha varietyofschoolingoptions.Themainchallenge isthatthehighwayrunsdirectlythroughthe neighborhoodcreatingamajorgapbetweenschools in the same district. It also causes a difficult crossing forchildrenwhowouldbewalkingtoschoolfromthe site.

School District
Site
Railroad
Residential Fabric
Schools

Image 55: Godwin Heights schools diagram


St. Joseph
Hillcrest Park
PENNELLWOOD
CHURCH OF
Godwin
Learnin

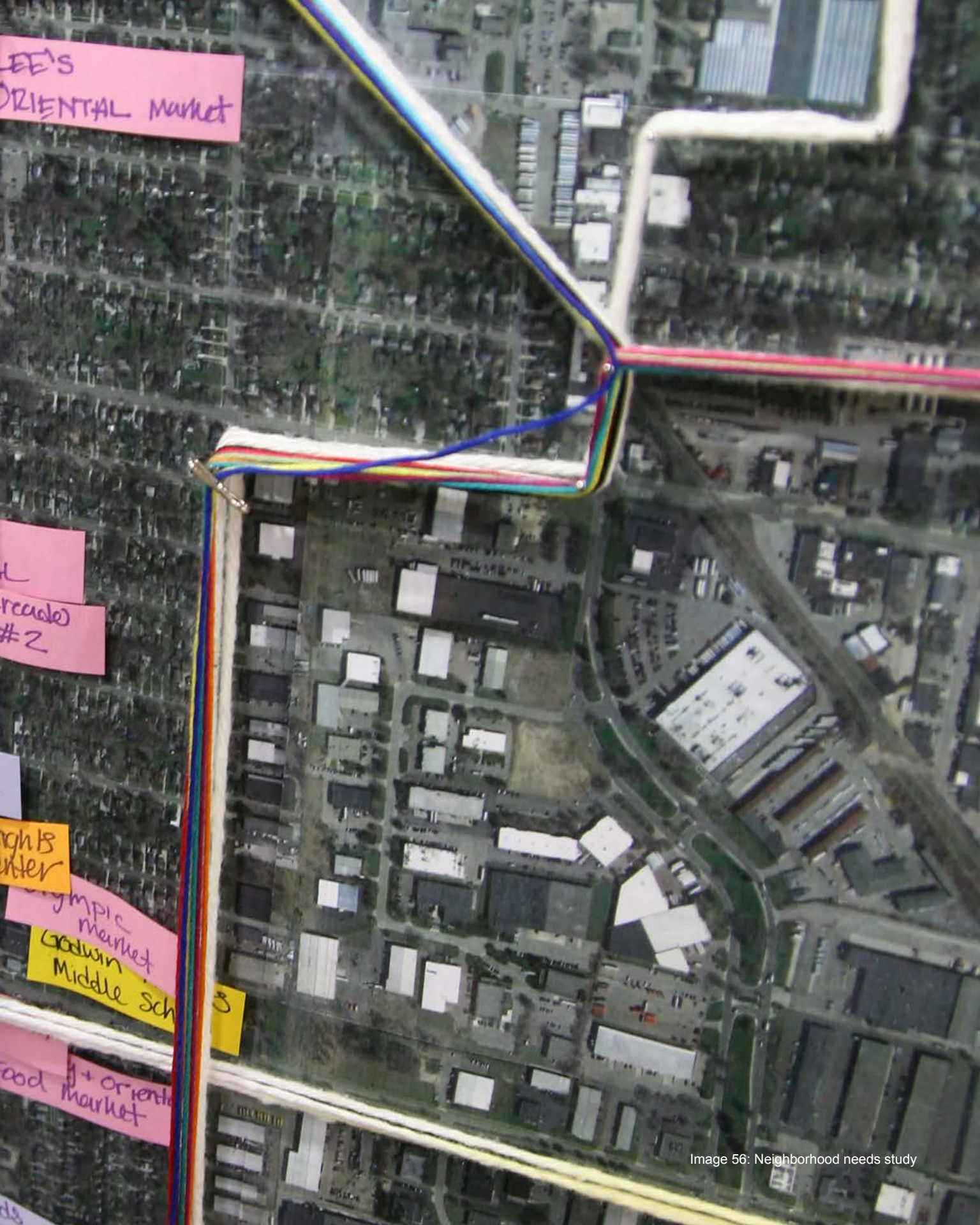
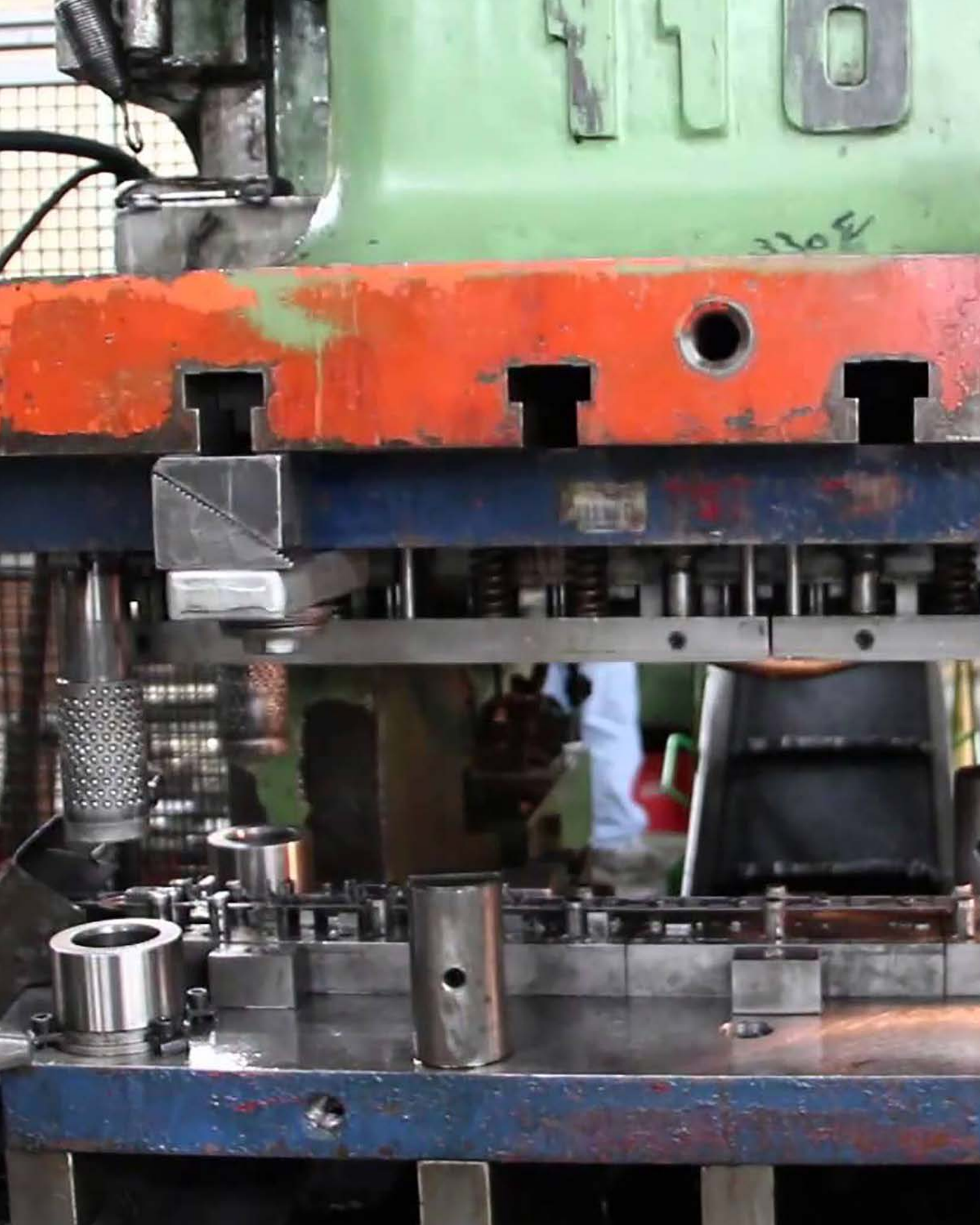
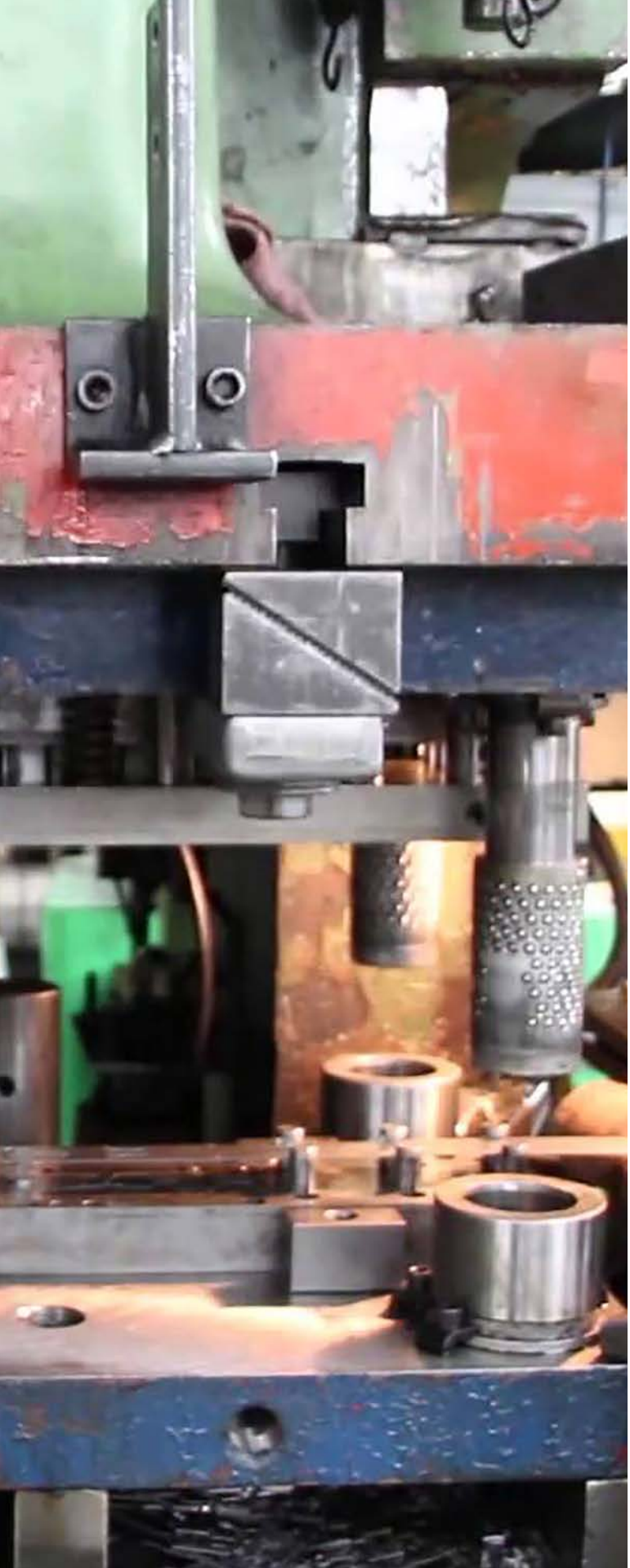


Image 56: Neighborhood needs study

PROGRAM





PROGRAMING

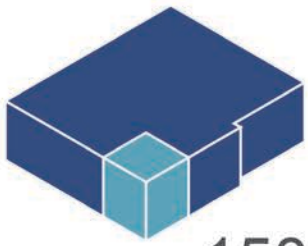
Inordertorethinkmanufacturingandhousinginthe innerringsuburbs,therevaluationofprograming playsanimportantrole.Toavoidcreatinganother voidinthefabricinthefuture,differentscalesof housingandmanufacturingwillbeimplementedon thesitecreatingacycleofsupportforeachpartof thepuzzle.

Image 57: Metal stamping machine

CURRENT LIVIN
CONDITIONS

ADEN MILES

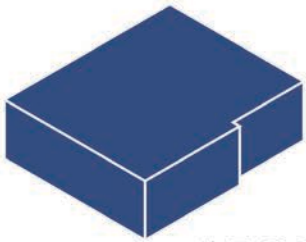
AGE: 25
EDUCATION: High School Education + Some Community College
CURRENT EMPLOYMENT: Unemployed
RELATIONSHIP STATUS: Single
CURRENT RESIDENCE: Living w/ Parents
CHILDREN: None



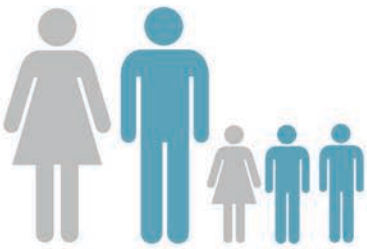
1500

MARKUS + BRITNEY HARRIS

AGE: 30 + 26
EDUCATION: High School Education + On Site Experience
CURRENT EMPLOYMENT: Gas Station Clerk + Sales Associate
RELATIONSHIP STATUS: Married
CURRENT RESIDENCE: Small Income Based Apartment in unsafe neighborhood
CHILDREN: 1 on the way



1500

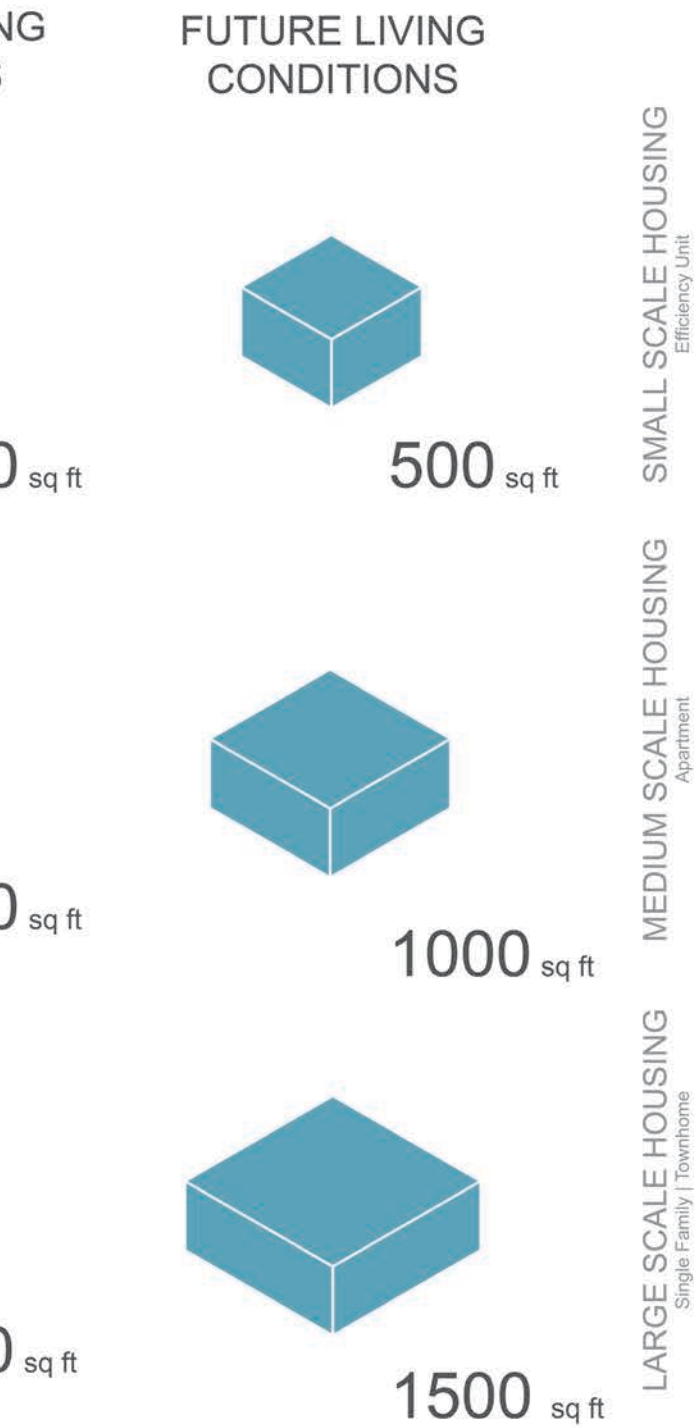


DAVID + MARIA GARCIA

AGE: 33 +31
EDUCATION: High School Education + Some Technical Training
CURRENT EMPLOYMENT: Factory work which is not providing adequate funds to provide for family
RELATIONSHIP STATUS: Married
CURRENT RESIDENCE: Small Bungalow w/ in laws and extended family
CHILDREN: 3 (ages 5,8,10)

1500

Image 58: Personas and three scales of housing diagram



THREESCALESOF HOUSING

ThroughdemographicresearchoftheGodwin Heightsneighborhood,threefamilytypologieshave been identified as candidates. Through these different familytypologies,threedifferenthousingtypeswillbe integratedonthesite.

Eachofthecandidatescurrentlyresideinabungalow ofabout1500squarefeet,butinrealitywhateachof thesetypologiesneedsisdifferentthentheircurrent livingconditions.

Havingthesethreescalesoflivingspaceswill accommodatethefamilylifecycleasfamiliesneeds changeovertimeallowingthemtoresideinthesite foraslongastheywish.

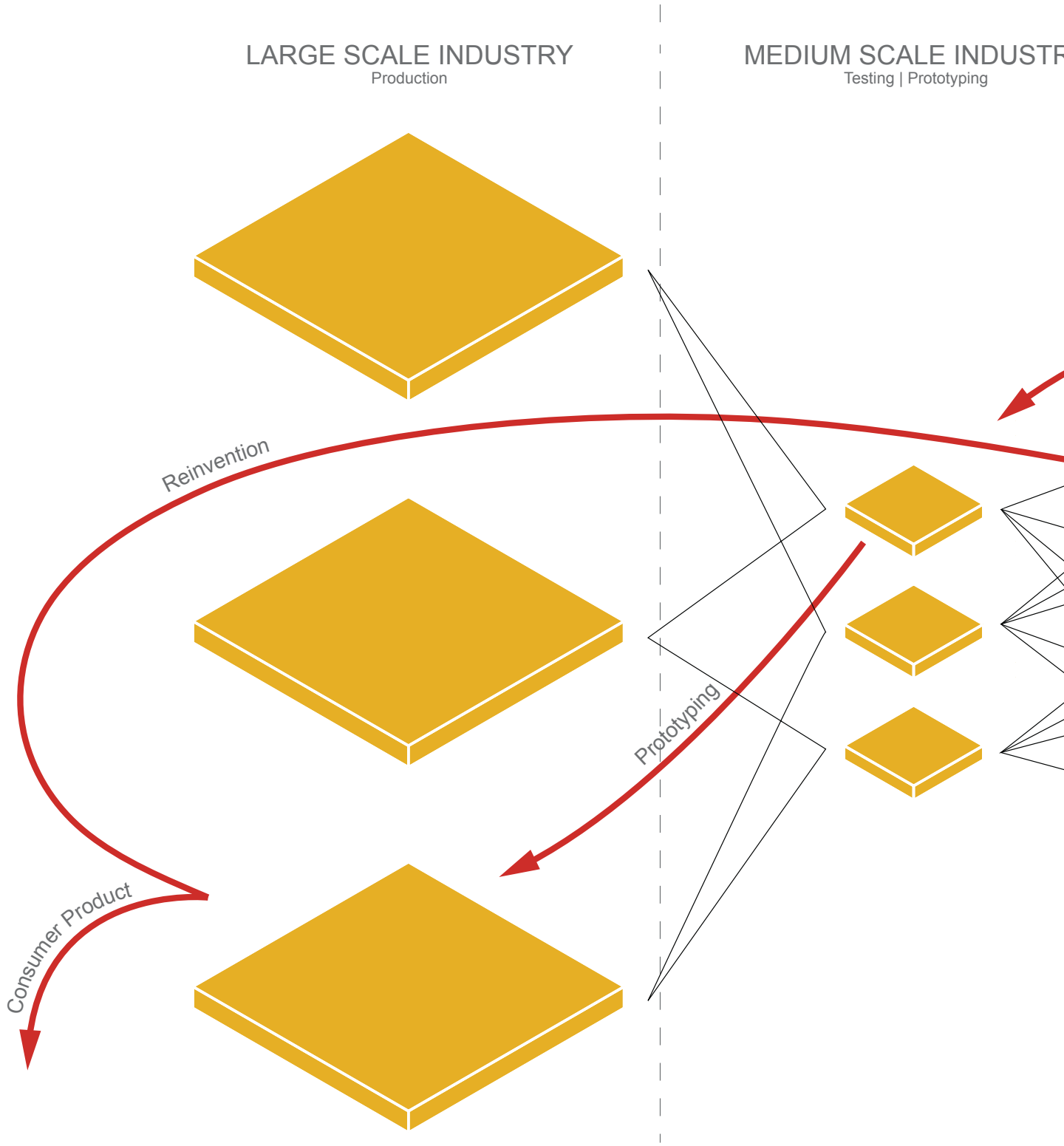
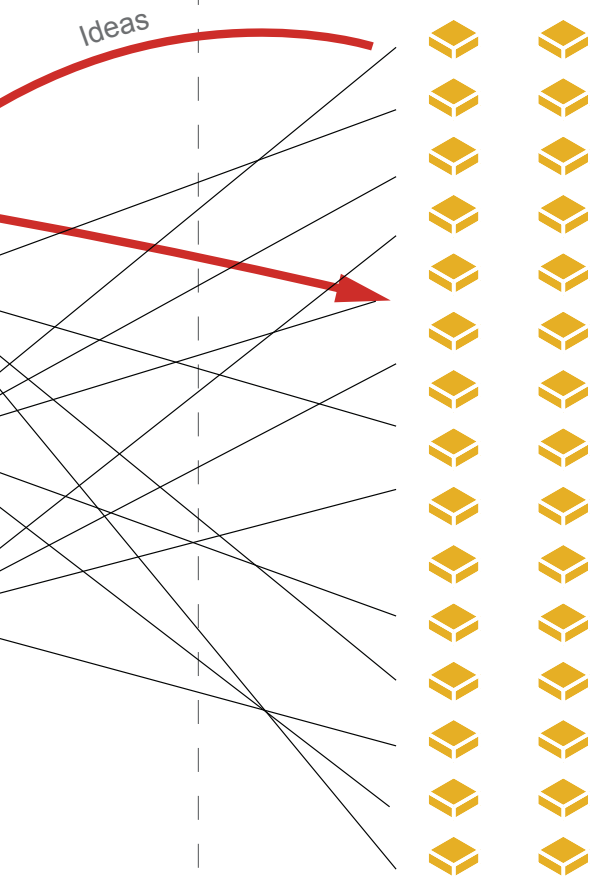


Image 59: Three scales of industry diagram

RY

SMALL SCALE INDUSTRY

Think Tank | Entrepreneurial Space



THREESCALESOF INDUSTRY

Similartotheprogramingofthehousing,therewill bethreescalesofwork.Bydoingthis,itcreatesa networkofcontinuoussupportandgrowth.Small incubatorsorthinkspaceswillfeedprototyping facilitiesthatthenfeedthethreelargescale manufacturingfacilities.Therefore;newideas, processes,andproductsarebeingcycledthroughfor lastingeconomicstability.

WORKPROGRAM

	Space	Qty	Occupants	BUILDING SF / Occupant	SF Each	TOTAL SF	GSF Multiplier	TOTAL GSF	SITE SF each	Qty	TOTAL
Work	Small Scale Industy (Think Space)										
	Work Space	45	10	100	1000	45000	1.3	58500			
	Restrooms					0	1.3	0			
	Storage	5	5	300	1500	7500	1.3	9750			
	Shipping / Delivery	1			2500	2500	1.3	3250			
	Mechanical	1				0		0			
	Electrical	1				0		0			
	Parking					0		0	25	100	2500
					Total	55000		71500			2500
	Medium Scale Industy (Testing Facilities)										
	Testing Space	3	50	250	12500	37500		0			
	Prototyping	3	20	60	1200	3600	1.3	4680			
	Tool Crib	3			400	1200	1.3	1560			
	Restrooms					0		0			
	Storage	3	2	300	600	1800	1.3	2340			
	Shipping / Delivery	2			2500	5000	1.3	6500			
	Mechanical					0		0			
	Electrical					0		0			
	Parking					0		0	25	100	2500
					Total	49100		15080			2500
	Large Scale Industy (Production)										
	Production Floor	3	300	400	120000	360000		0			
	Tool Crib	3			400	1200		0			
	Locker Rooms	2	200	50	10000	20000		0			
	Storage	3	10	500	5000	15000		0			
	Docks	12			400	4800		0			
	Shipping / Delivery	3			2500	7500		0			
	Restrooms					0		0			
	Mechanical					0		0			
	Electrical					0		0			
	Parking	1			0	0		0	375	200	75000
					Total	408500		0			75000
	Shared Spaces										
	Cafeteria	1	400	15	6000	6000		0			0
	Kitchen	1	5	200	1000	1000		0			0
	Maintenance Shop	1	10	200	2000	2000		0			0
	Storage	1	5	500	2500	2500		0			0
					Total	9000		0			
					28% Total Work	521600					

LIVEPROGRAM

	Space	Qty	Occupants	BUILDING SF / Occupant	SF Each	TOTAL SF	GSF Multiplier	TOTAL GSF	SITE SF each	Qty	TOTAL
Live	High Density Housing (Communal Rooms)										
	Units	500	1125	200	450	225000	1.3	292500			0
	Laundry (Shared)	10			500	5000	1.3	6500			0
	Mechanical					0		0			0
	Electrical					0		0			0
	Parking	1			0	0		0	500	400	200000
					Total	230000		299000			200000
	Medium Density Housing (Apartments)										
	Units	500	2000	200	800	400000	1.3	520000			0
	Mechanical					0		0			0
	Electrical					0		0			0
	Parking	1				0		0	500	400	200000
					Total	400000		520000			200000
	Low Density Housing (Single Family Houses)										
	Houses	100	6	200	1500	150000		0	6500	100	650000
					Total	150000		0			650000
					42% Total Live	780000					

“GREENSPACE”PROGRAM

	Space	Qty	Occupants	BUILDING SF / Occupant	SF Each	TOTAL SF	GSF Multiplier	TOTAL GSF	SITE SF each	Qty	TOTAL
3rd Space	Headquarters/Leasing Office										
	Lobby	1			500	500	1.3	650			0
	Open Office Space	1	25	100	2500	2500	1.3	3250			0
	Conference Rooms	2	10		250	500	1.3	650			0
	Storage	1	2	500	1000	1000	1.3	1300			0
	Copy Room	1			120	120	1.3	156			0
	Restrooms	1				0		0			0
	Parking	1				0		0	100	25	2500
					Total	4620		6006			2500
	Daycare										
	Entry	1			500	500	1.3	650			0
	Offices	1	2	100	200	200	1.3	260			0
	Playroom	1	150	35	5250	5250	1.3	6825			0
	Classrooms	5	15	40	600	3000	1.3	3900			0
	Kitchenette	1			150	150	1.3	195			0
	Restrooms					0	1.3	0			0
	Storage	1			500	500	1.3	650			0
	Playground	1				0		0	10000	1	10000
					Total	9600		12480			10000
	Training Facilities										
	Afterschool Classrooms	3	30	40	1200	3600	1.3	4680			0
	Training Classrooms	3	20	100	2000	6000	1.3	7800			0
	Workshop	1	50	50	2500	2500	1.3	3250			0
	Restrooms					0		0			0
					Total	12100		15730			0
	Community Wellness Center										
	Gym	1			4200	4200	1.3	5460			0
	Fitness Center (weight and cardio)	1	50	50	2500	2500	1.3	3250			0
	Group Exercise Room	2	20	50	1000	2000	1.3	2600			0
	Pool	0			25000	0	1.3	0			0
	Climbing Wall	0			1500	0	1.3	0			0
	Game Room/ Teen Hangout	1	20	50	1000	1000	1.3	1300			0
	Party Room/ Rental Space	2	75	20	1500	3000	1.3	3900			0
	Locker Room	2	50	50	2500	5000	1.3	6500			0
	Storage	1				1500	1.3	1950			0
	Mechanical					0	1.3	0			0
	Electrical					0	1.3	0			0
	Restrooms					0	1.3	0			0
	Retail Space										
	Shops/Cafes	25			1500	37500	1	37500			0
	Shipping/Delivery	1			2500	2500	1.3	3250			0
	Restrooms				0	0	1.3	0			0
					Total	40000		40750			0
	Performance/Gathering Space/Amphitheater										
	Performance Space Stage	1	40	15	600	600		0			0
	Performance Space Seating	1	1500	7	10500	10500		0			0
	Gathering Space	2	100	15	1500	3000		0			0
					Total	14100		0			0
	Outdoor Public Space										
	Garden	1			5000	5000	1.3	6500			0
	Recreational Trail	0			316800	0	1	0			0
	Open Public Space	1			450000	450000	1	450000			0
	Splash Pad	1			5000	5000	1.3	6500			0
	Outdoor Basketball Court	1			4200	4200	1.3	5460			0
	Pedestrian Boulevard	0			12000	0	1.3	0			0
	Storage	1			1000	1000	1.3	1300			0
	Outdoor Plaza/Food Court	1			6000	6000	1.3	7800			0
					Total	471200		477560			0
				30%	Total Third	570820					

Whenindustryandhousingcometogether"green space"iscreated."Greenspace"iswhatallows livingandworkingtocoexist.Itisthecommon spacebetweenthetwoandincludesspaces suchaseducationandtraining,socialgathering, entertainment,andcommunitywellness.Both industry and housing flourish from the "green space."

Image 60: Program documents

PROGRAMELEMENTSRELATIVETOSPACE ALLOCATION

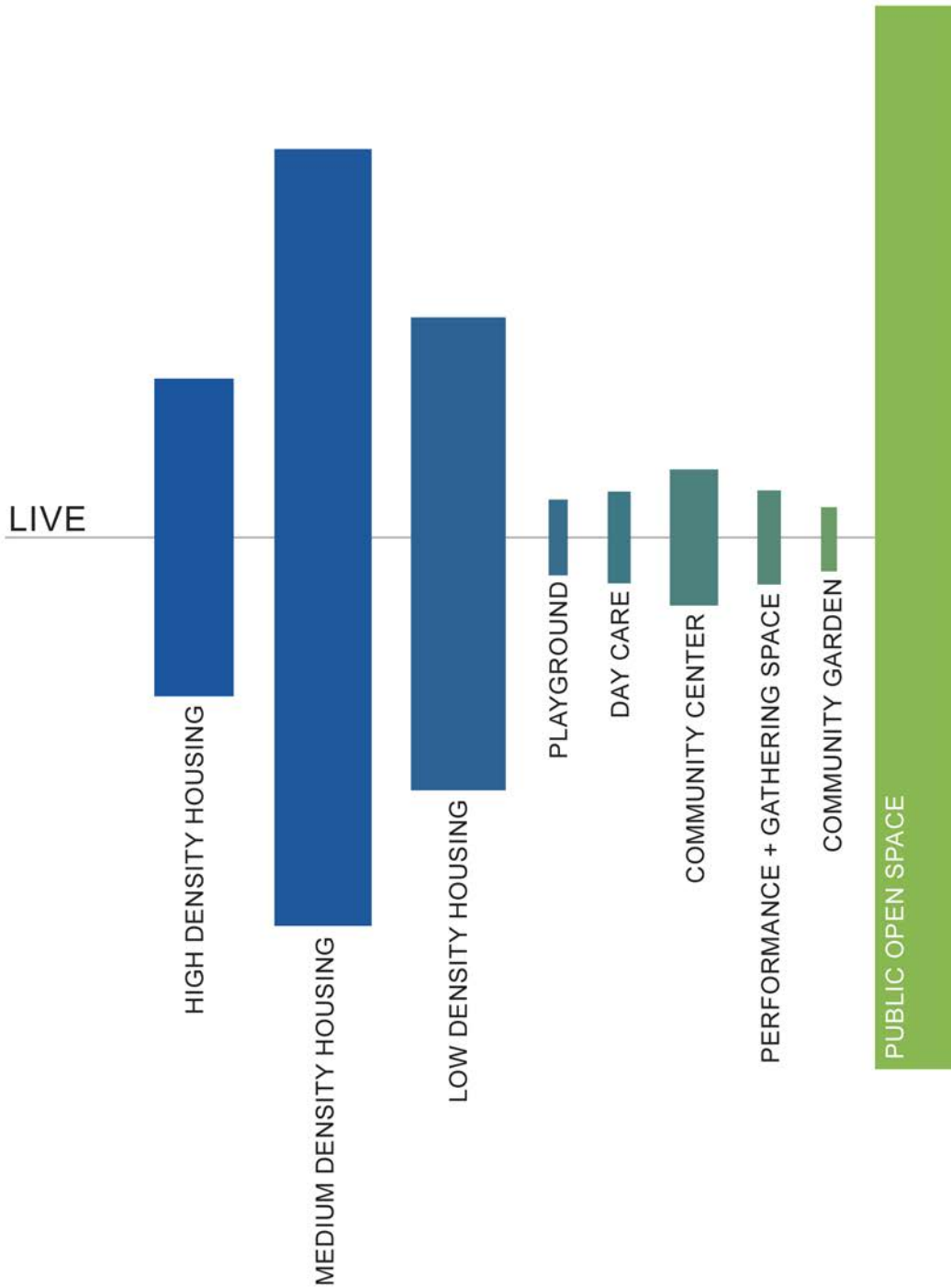
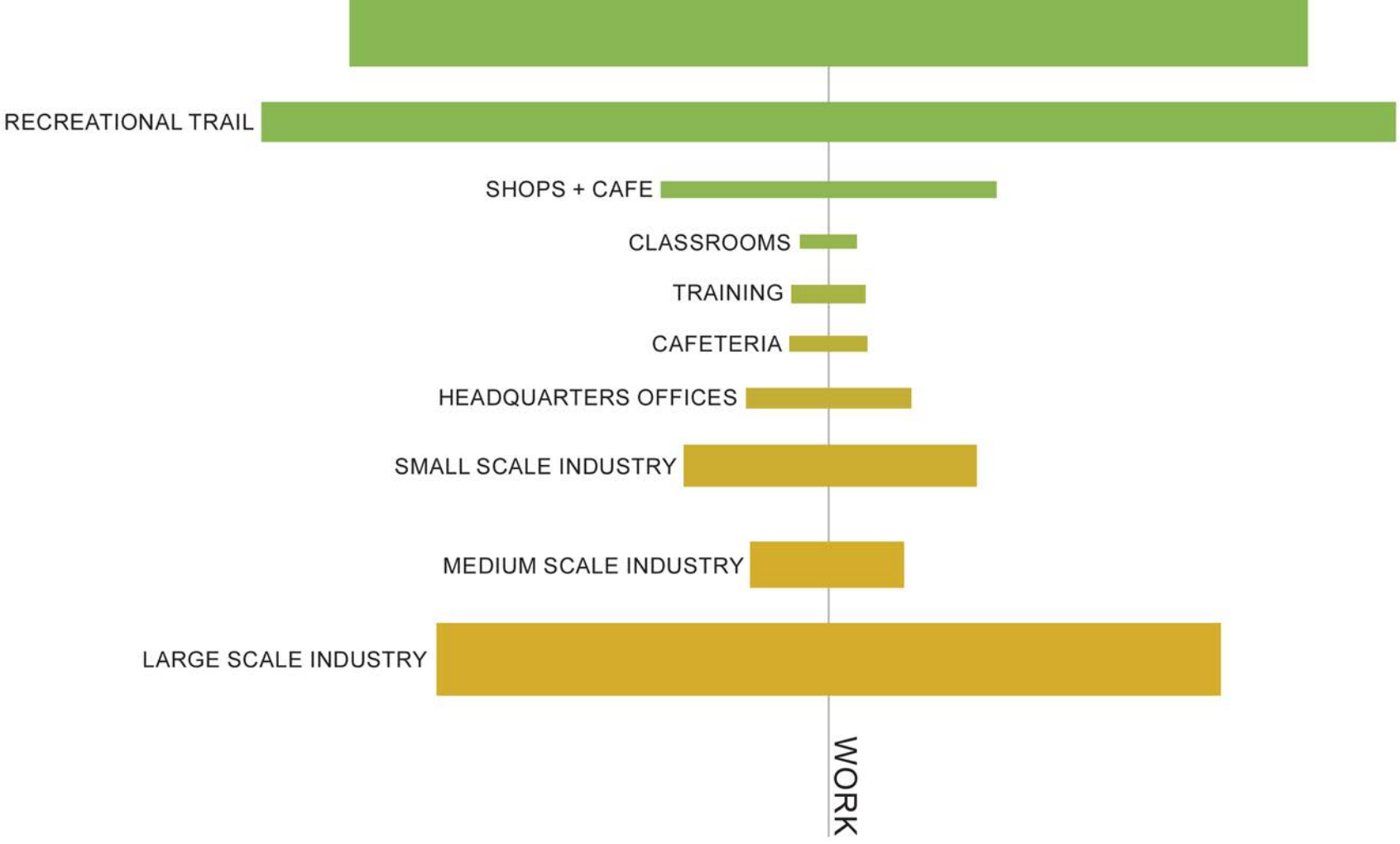


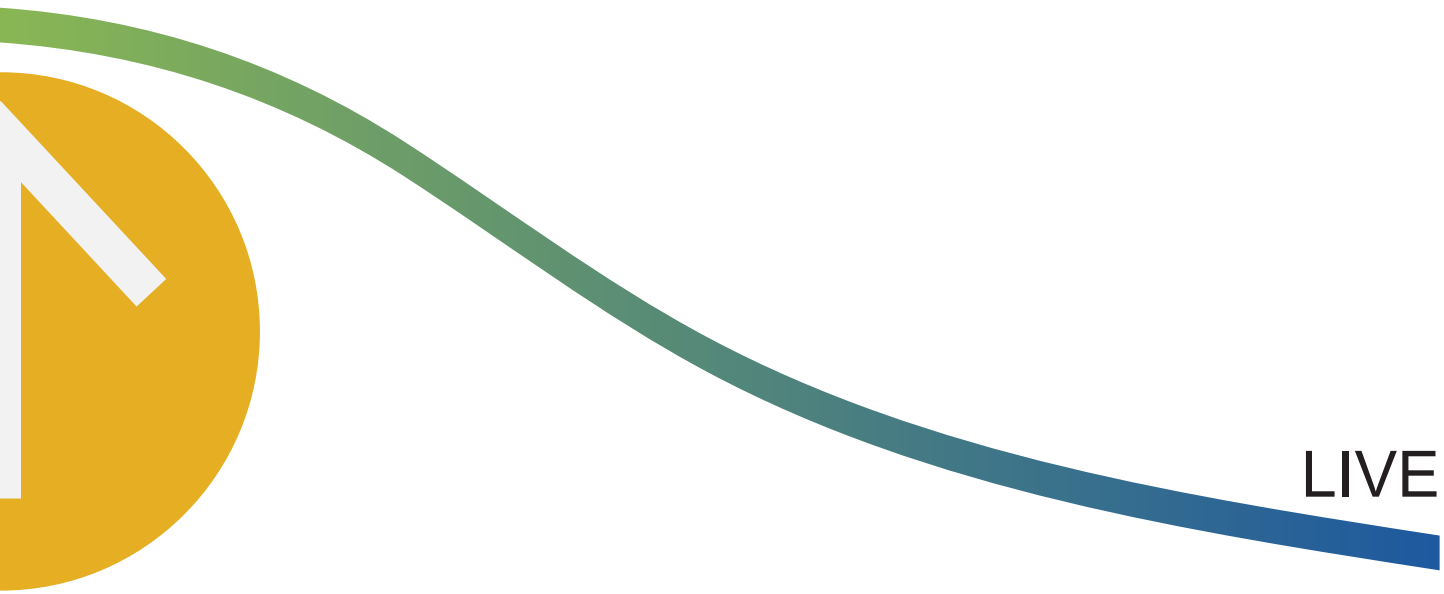
Image 61: Program elements relative to space allocation


RECREATIONAL TRAIL
SHOPS + CAFE
CLASSROOMS
TRAINING
CAFETERIA
HEADQUARTERS OFFICES
SMALL SCALE INDUSTRY
MEDIUM SCALE INDUSTRY
LARGE SCALE INDUSTRY
WORK

“GREENSPACE”CREATEDTHROUGHTHE INTERSECTIONOFLIVINGANDWORKING

Whenthinkingofindustryorworkasanoperatoron suburbanfabric,thetransformationthathappenswhen fabricisoperatedoncreatesthe"greenspace."For instance,whenanindustrialbuildingpushesupthrough thefabricitstretchesittocreatenewspace.

Image 62: Program operation diagrams



WORK

SOCIALAIMS

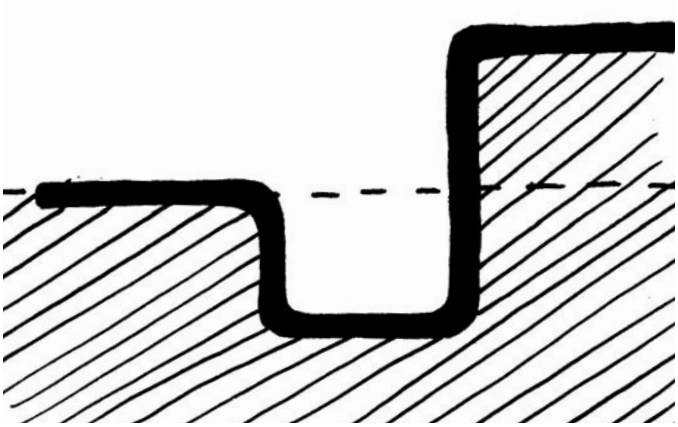


Image 63: Remediation diagram

REMEDIATION

All contaminated soil will remain on site, and not end up in a landfill. Level of contamination will decrease with the implementation of this project.

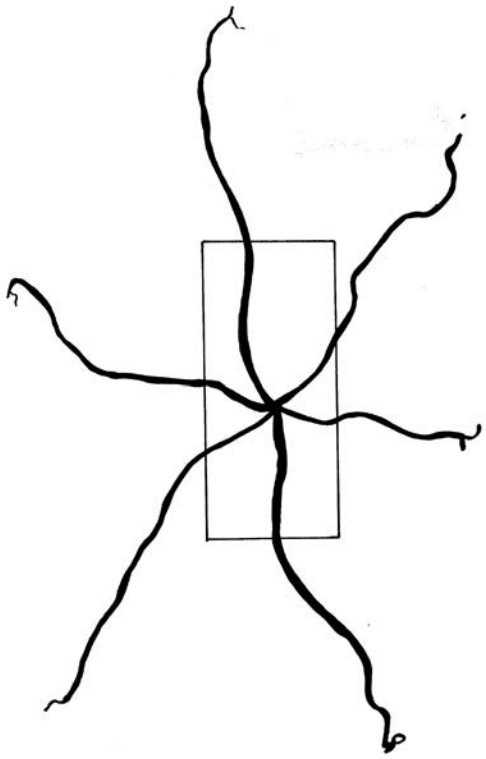


Image 64: Connection diagram

CONNECTION+OUTREACH

Stitch the site back into the existing neighborhood, and reach out across boundaries to attract people to the site.

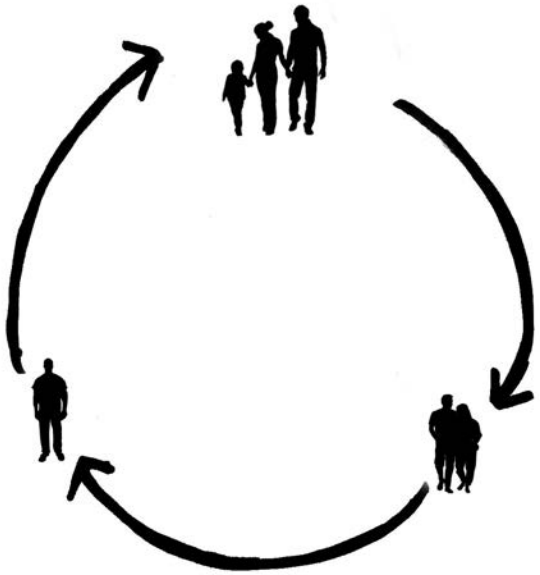


Image 65: Neighborhood needs diagram

NEIGHBORHOODNEEDS

The site will serve the needs of the immediate community and provide the opportunity for people to “age in place” + “work in place.”

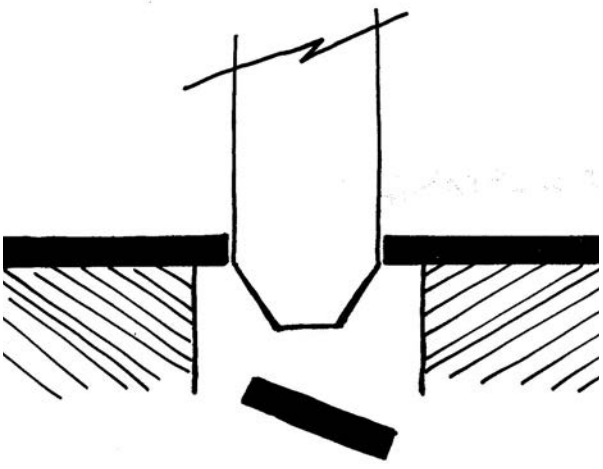


Image 66: Stamping diagram

SENSE OF PLACE + HISTORY

Site must have a sense of history and what was before it. Reflecting the stamping process and community hub.

PROPOSAL

FILLINGTHEVOID

Howdoesthissiteweave,stitchorstretchits waybackintothesurroundingneighborhood? Thediagramtotherightshowshowtheexisting residentialblockswillextendintothesite,but whentheybumpintoindustrythatiscappingoff contaminantstheexistingblockstransform.Where theytransformthe"greenspace"isformed.

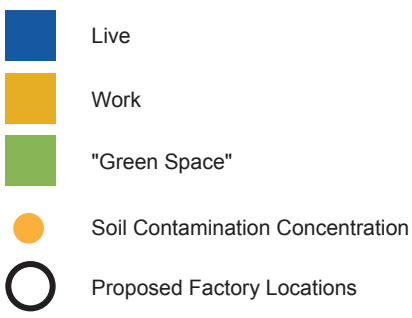
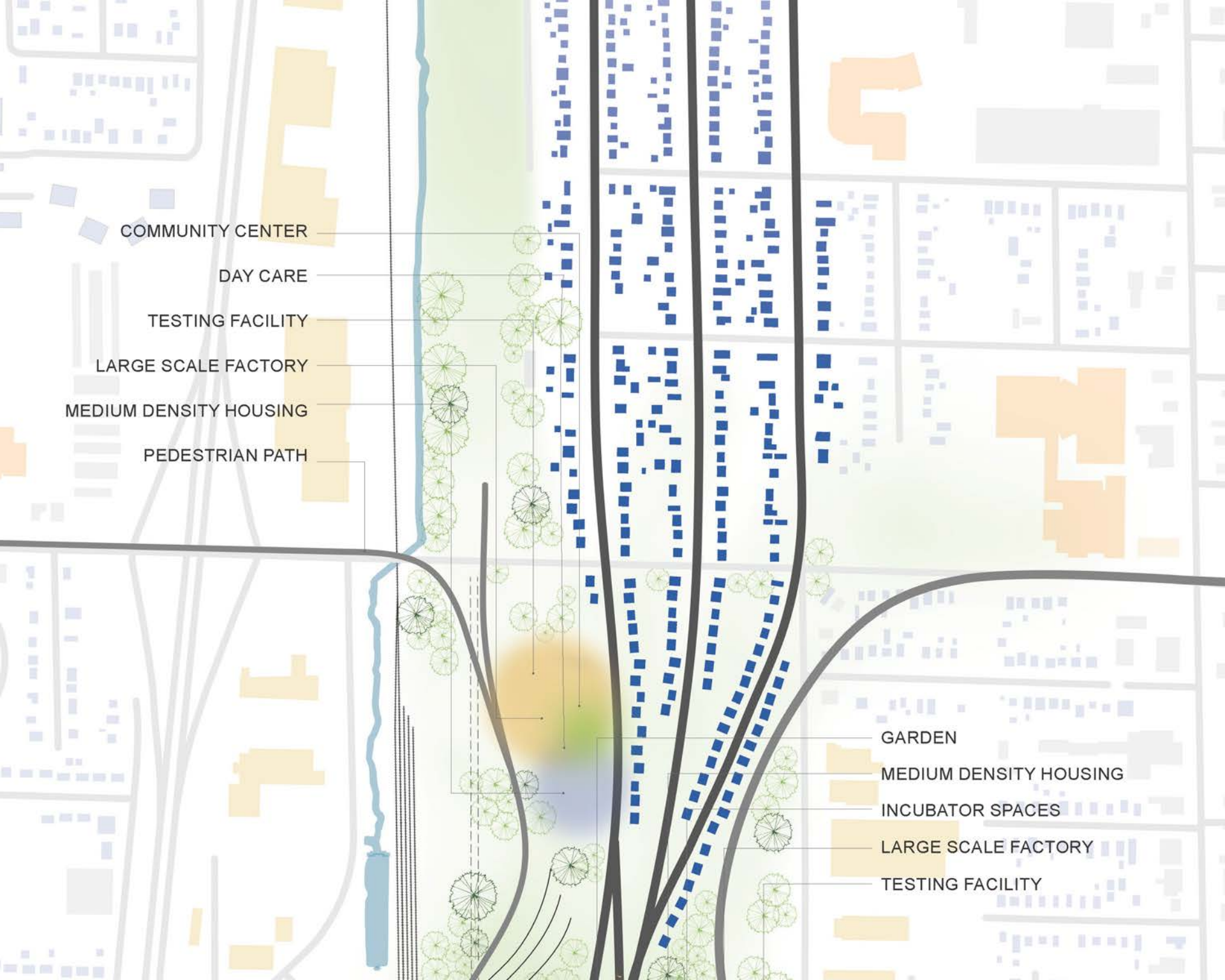


Image 67: Site diagram: stitching/weaving site back into neighborhood


COMMUNITY CENTER
DAY CARE
TESTING FACILITY
LARGE SCALE FACTORY
MEDIUM DENSITY HOUSING
PEDESTRIAN PATH
GARDEN
MEDIUM DENSITY HOUSING
INCUBATOR SPACES
LARGE SCALE FACTORY
TESTING FACILITY

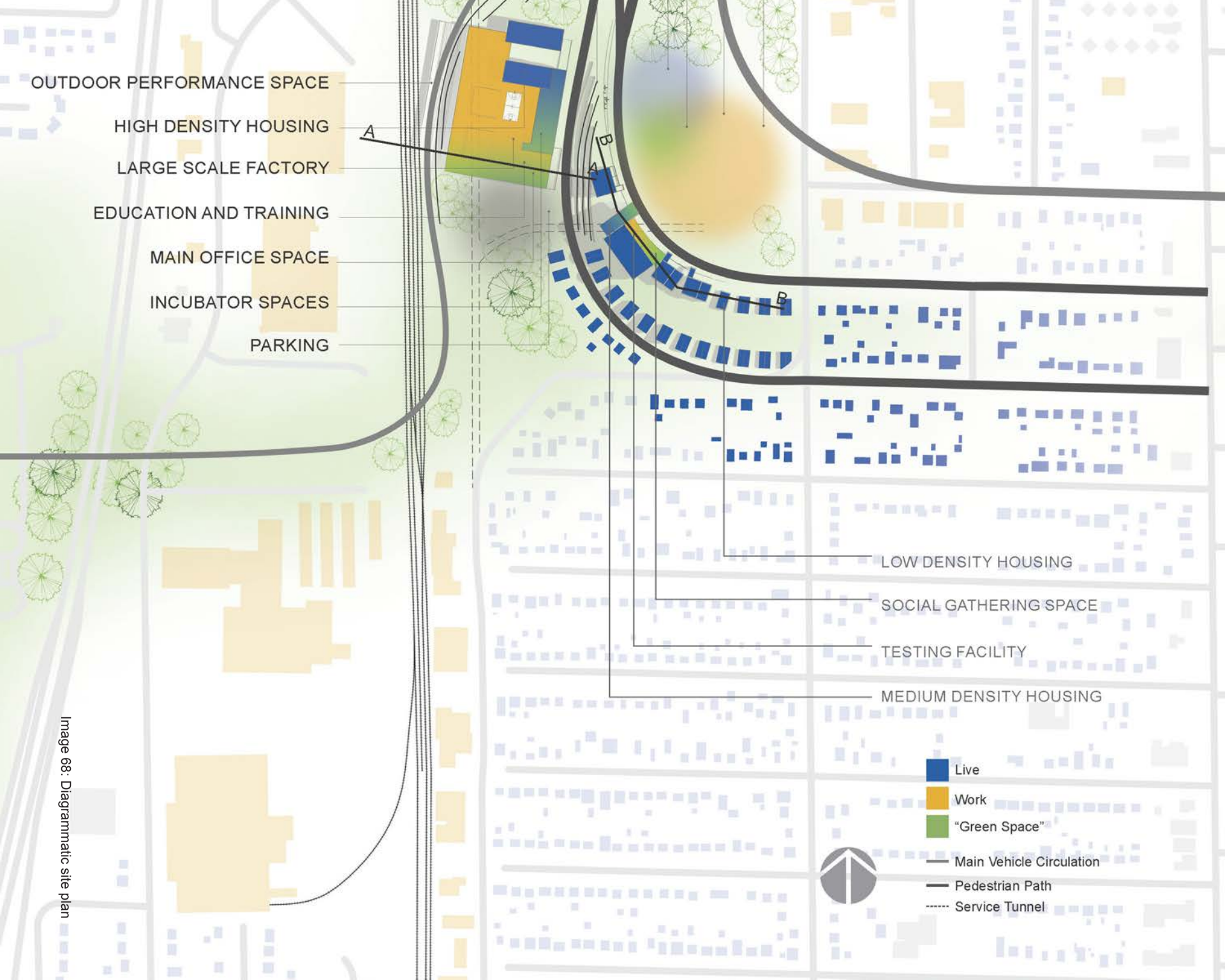
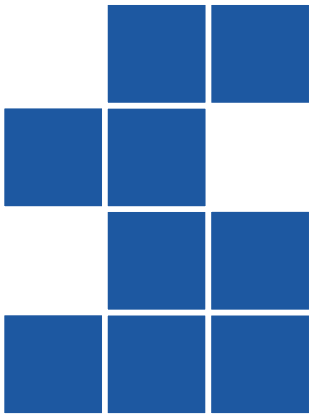


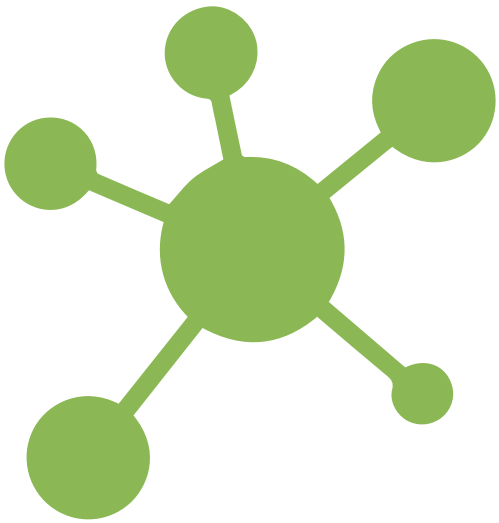
Image 68: Diagrammatic site plan

HEMMING

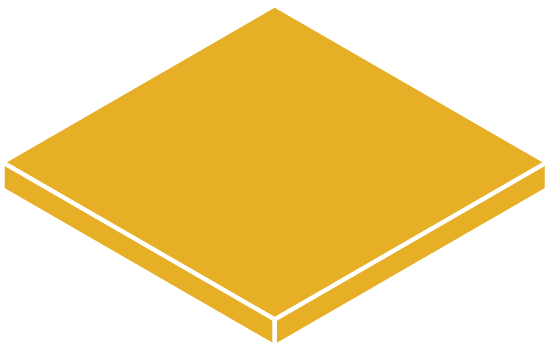
EXPLORED RELATIONSHIPS



SMALL SCALE HOUSING
LOW DENSITY EFFICIENCY UNITS

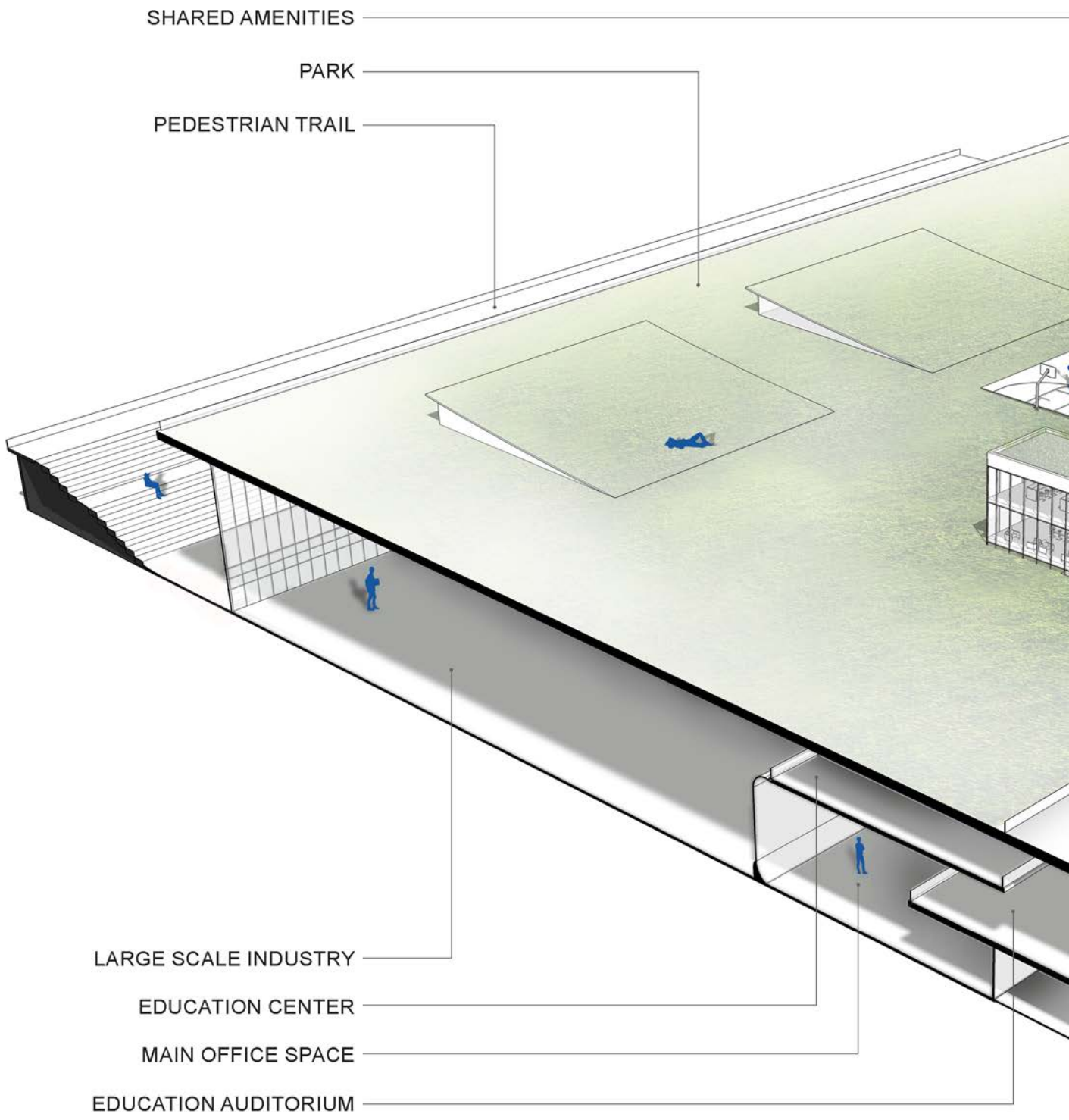


OUTREACH + EDUCATION

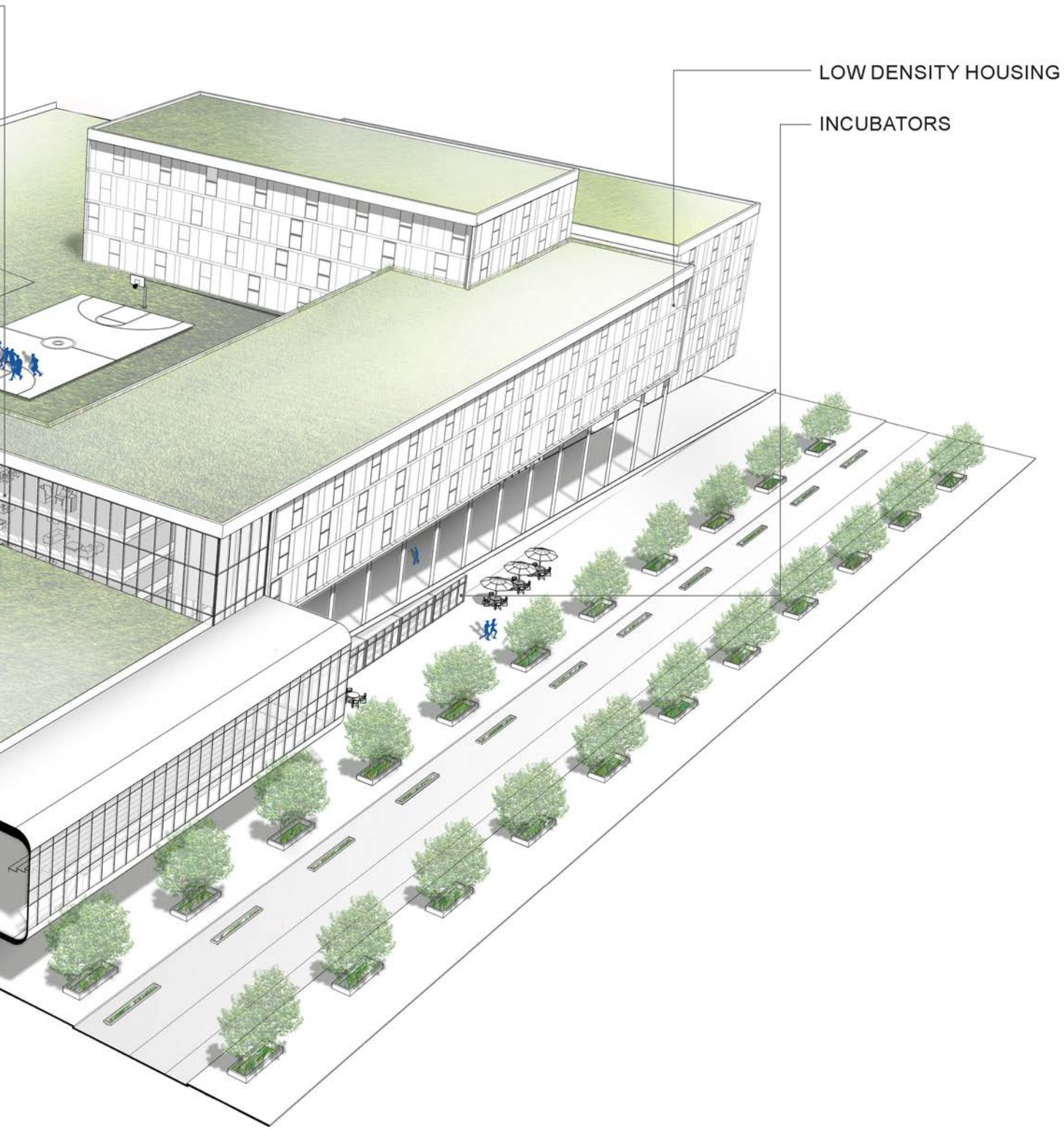


LARGE SCALE INDUSTRY
PRODUCTION

Image 69: Hemming program relationship diagram

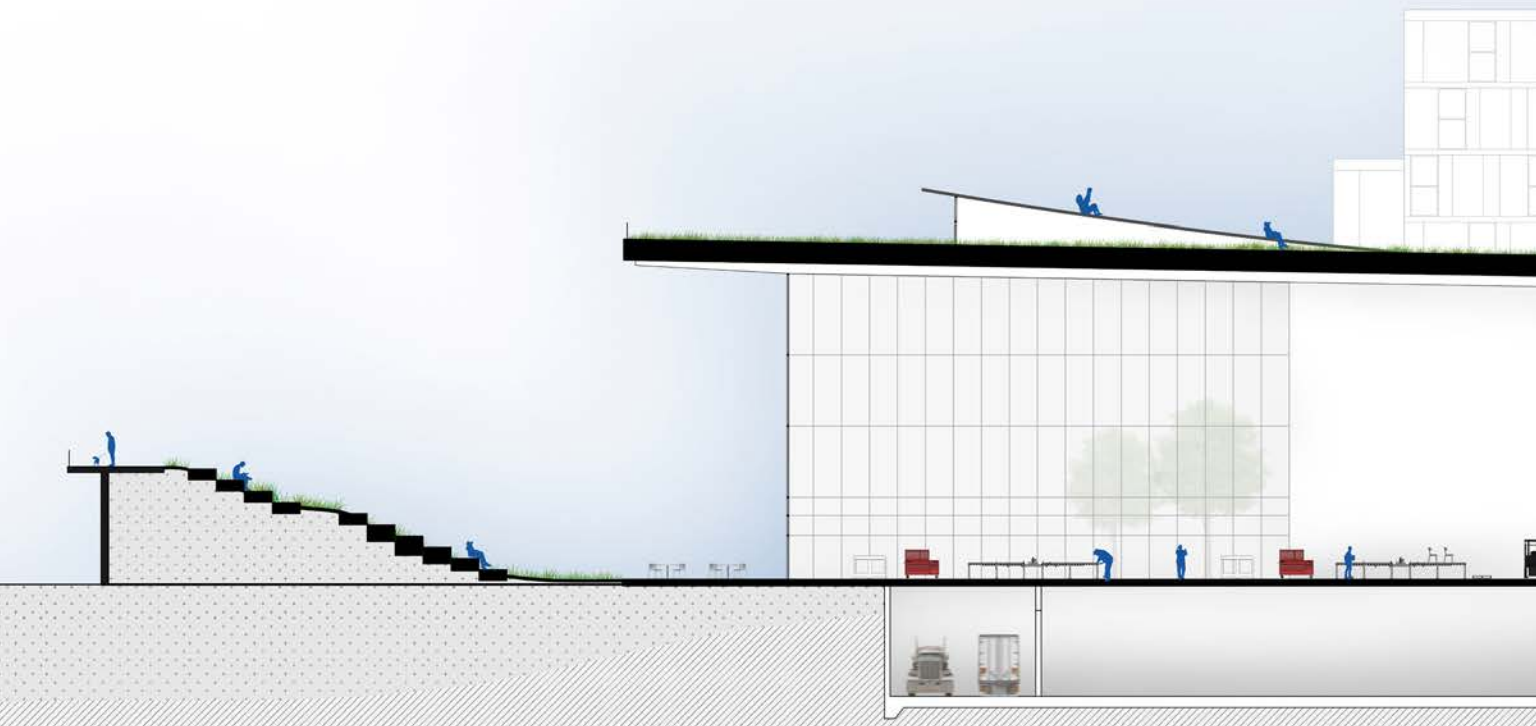


AERIALVIEWATSECTIONA:HOUSINGMEETSEDUCATIONANDINDUSTR



USTRY

Image 70: Hemming perspective view

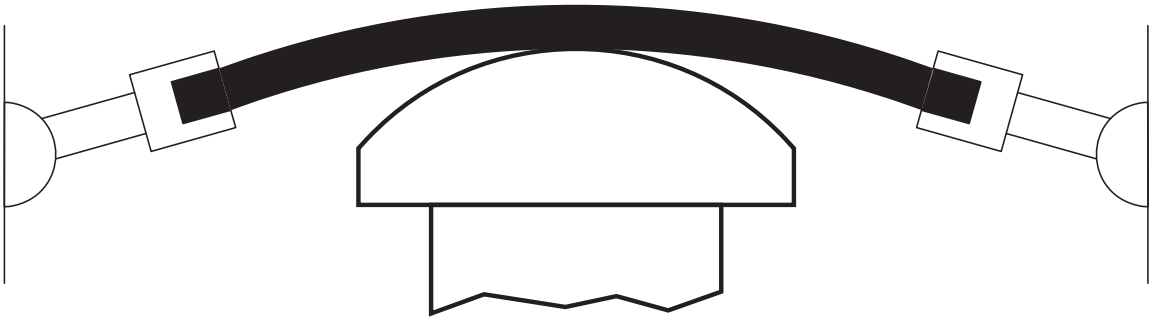


SECTIONA:LARGESCALEINDUSTRYMEETSEDUCATION

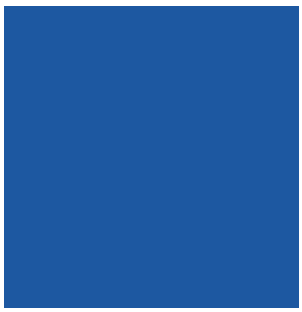
Image 71: Hemming section

Image 72: Hemming rendering

STRETCHING

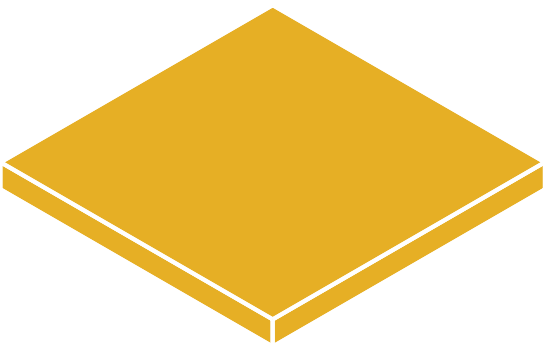


EXPLORED RELATIONSHIPS



LARGE SCALE HOUSING
SINGLE FAMILY HOMES

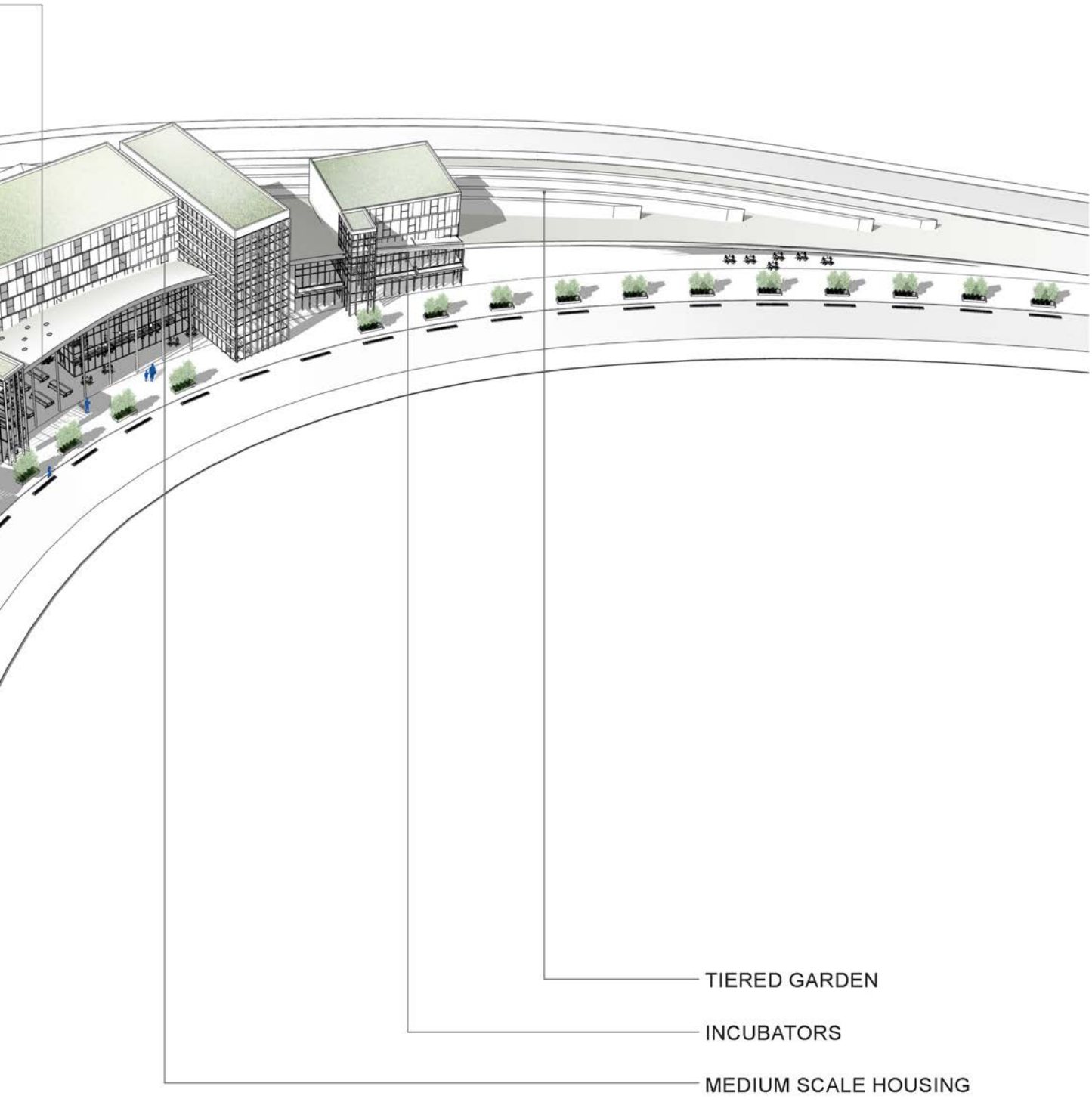
SOCIAL GATHERING SPACE



MEDIUM SCALE INDUSTRY
TESTING + PROTOTYPING

Image 73: Stretching program relationship diagram

AERIALVIEWATSECTIONB:TESTINGMEETSSOCIALSPACEANDHOUSI



OUSING

Image 74: Stretching perspective view

SECTIONB:TESTINGMEETSSOCIALSPACEANDHOUSING

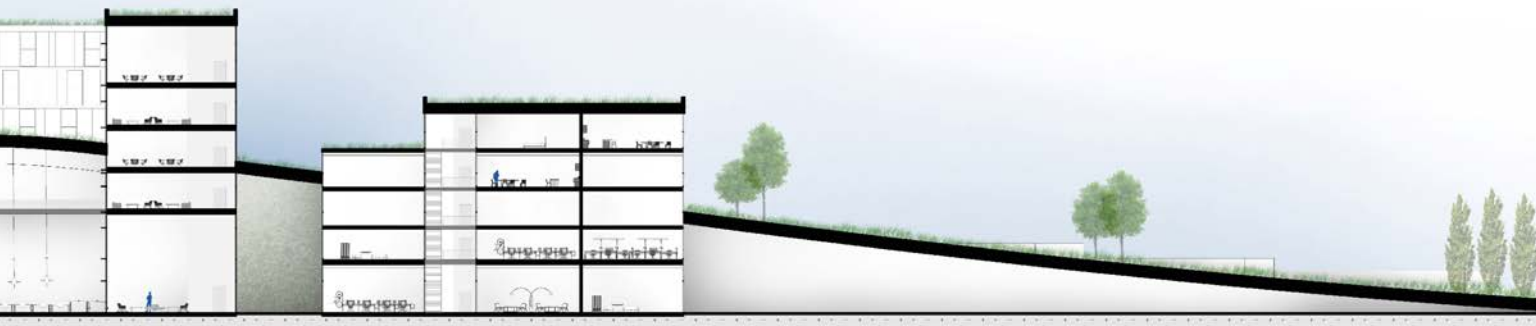


Image 75: Stretching section

Image 76: Stretching rendering

APPENDIX A: THESIS EXHIBITION

bicki • Masters of Architecture

LIVE WORK OPERATIONS

ARCHITECTURE

LIVE WORK RELATIONSHIPS IN INNER RING SUBURBS

GIVING FORM TO FABRIC

Image 77: Thesis Exhibition

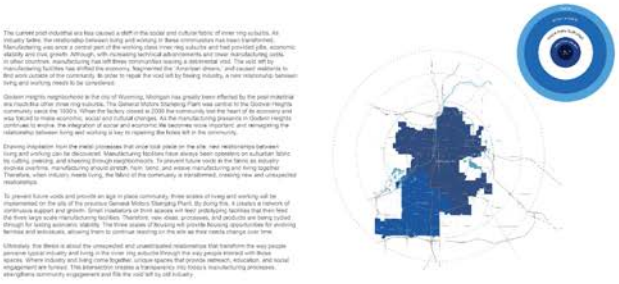
Image 78: Thesis Exhibition Models

Image 79: Thesis Exhibition Model

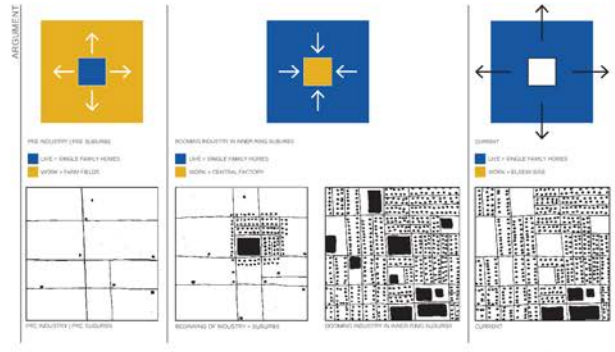
Image 80: Thesis Exhibition Model

Image 81: Thesis Exhibition (Left)

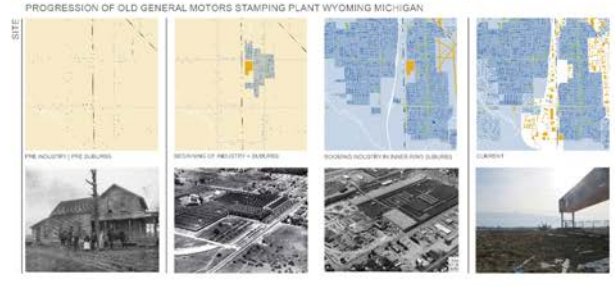
Image 82: Thesis Defense



LIVE WORK RELATIONSHIPS IN INNER RING SUBURBS



PROGRESSION OF OLD GENERAL MOTORS STAMPING PLANT WYOMING MICHIGAN



GIVING FORM TO FABRIC

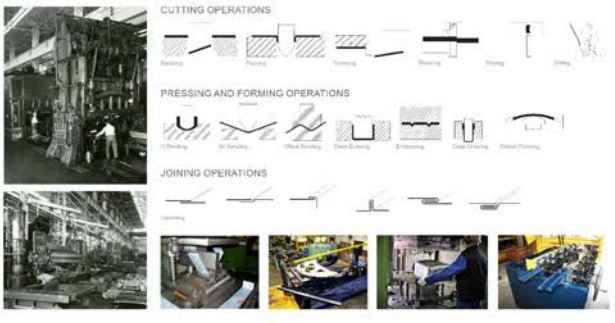


Image 83: Thesis exhibition board 1, Argument

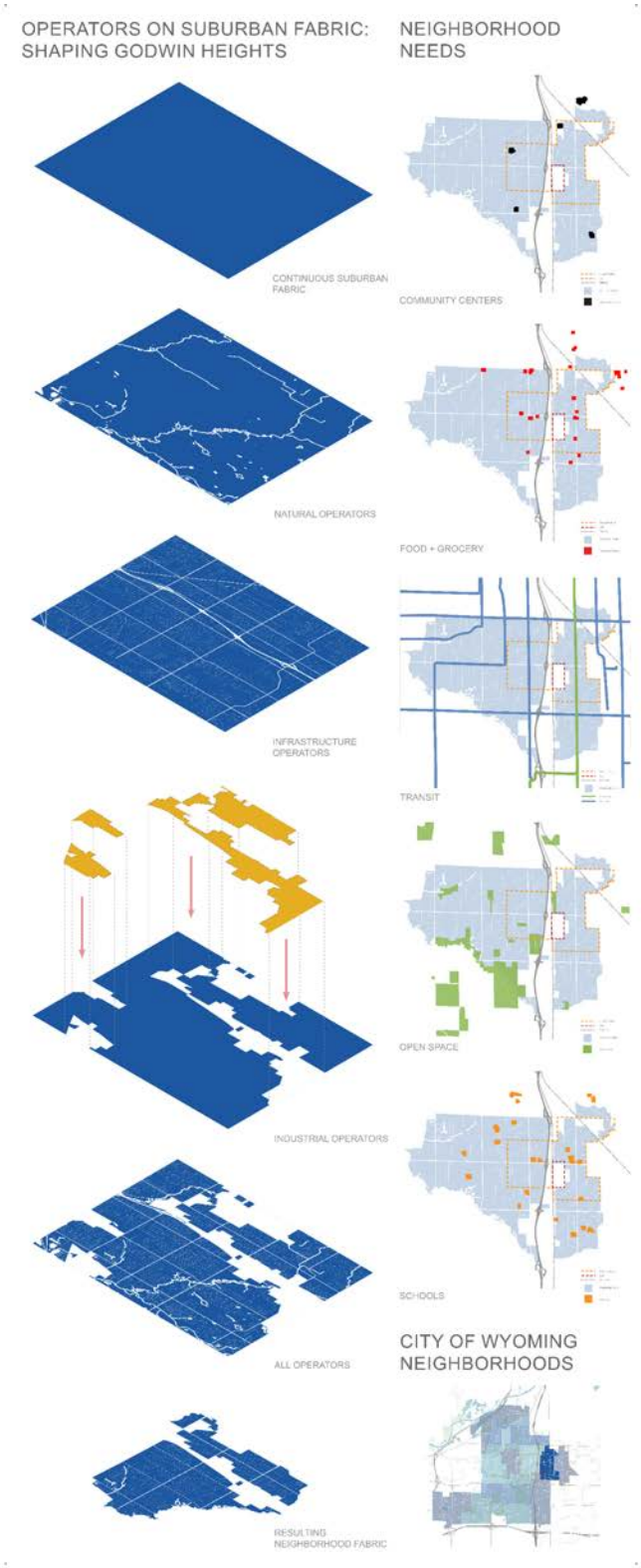


Image 84: Thesis exhibition board 2, Neighborhood

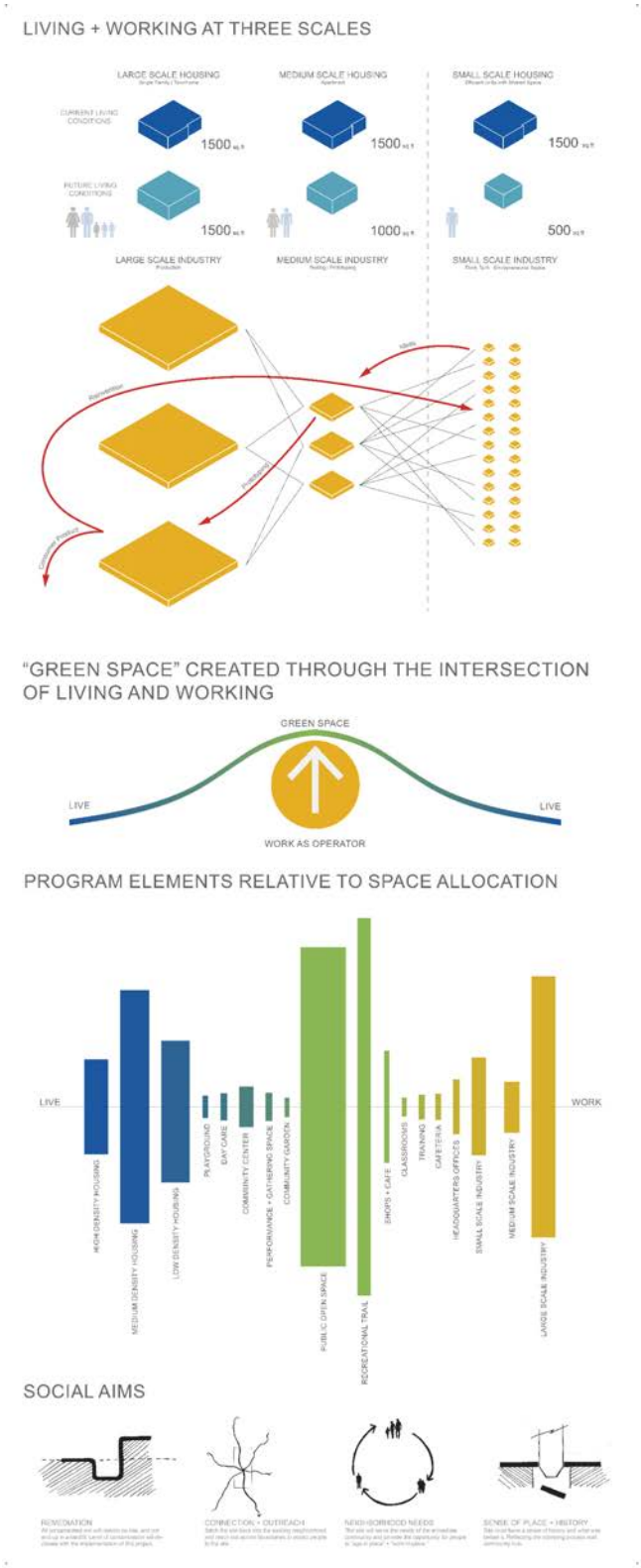


Image 85: Thesis exhibition board 3, Program

Image 86: Thesis exhibition board 4, Site diagram

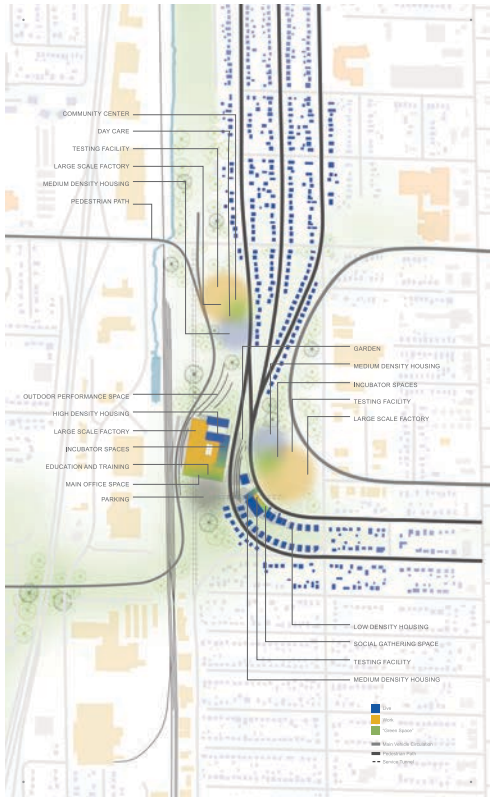


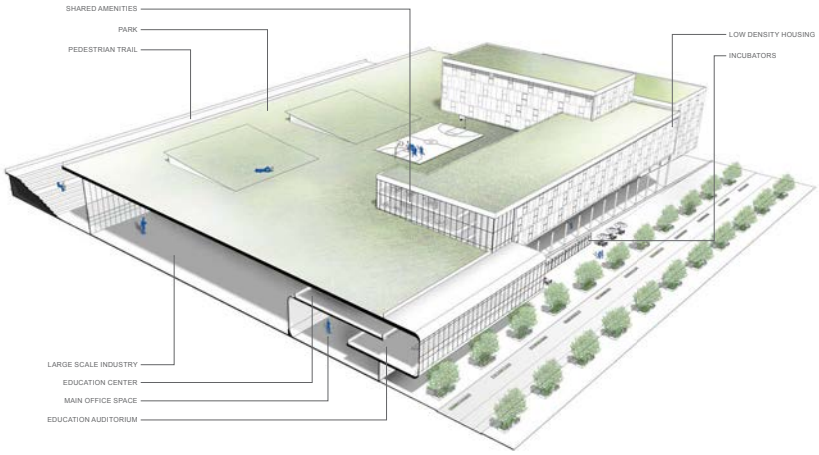
Image 87: Thesis exhibition board 5, Site plan

HEMMING

METAL OPERATION

EXPLORED RELATIONSHIPS

PROPOSED RELATIONSHIP



AERIAL VIEW: HOUSING MEETS EDUCATION AND INDUSTRY

SECTION A: LARGE SCALE INDUSTRY MEETS EDUCATION

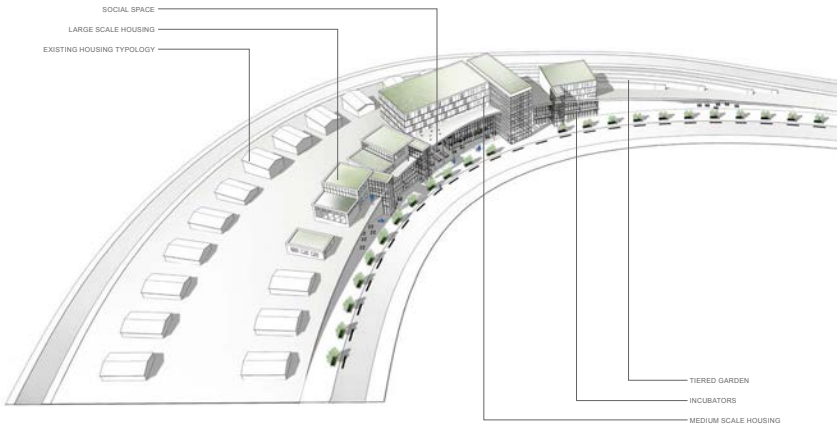
Image 88: Thesis exhibition board 6, Hemming

STRETCHING

METAL OPERATION

EXPLORED RELATIONSHIPS

PROPOSED RELATIONSHIP



AERIAL VIEW: TESTING MEETS SOCIAL SPACE AND HOUSING

SECTION B: TESTING MEETS SOCIAL SPACE AND HOUSING

Image 89: Thesis exhibition board 7, Stretching

APPENDIX B: PRECEDENT

PRECEDENT:PEGATRON CORPORATION

Asapartofthisthesis,providingasourceofincome tothoselow-incomefamiliesthatwouldresideinthis newhousingtypologyisanimportantpieceofthe overallsystem.Byprovidingasourceofincometo theresidents,itwillhelpelevatethoseindividualsand familiestobecomemoreupwardlymobile.

Onaneighty-acresitethatwasonceamassive GeneralMotorsstampingplant,onewaytoprovide asourceofincomewouldbetoreinventatypology ofhousingthatmergeslow-incomehousingwith amanufacturingincomegenerator.ThePegatron CorporationinShanghaiwhichisoneofApple's biggestsuppliers,isaprecedentinwhichtostudy howmanufacturingcaninteractwithideasregarding domesticity.

AtthePegatronCorporation,employeeseat, sleepandworkonsite.Thefacilitycoversanarea equal to almost ninety football fields.[47] Toputthis into perspective, ninety American football fields is approximately118acres.Incomparison,theeighty-acresiteinGrandRapidsisabout67%smaller insizetothePegatronCorporation.Toprovide theneedsofthosewholiveandworkthere,the complexisorganizedinsomewayslikeacollege campusorsmalltown.Inthecenterofthefacility, there is a firehouse, police station and post office.[48] Throughoutthecampustherearemega-cafeterias, landscapedlawns,koipondsandhousingfacilities. Workerstravelwithinthecampusbycampusshuttle buses.[49]

Onpaper,thePegatronCorporationseemslikea decentplacetoworkinregardstothecultureof manufacturing.Although,theconditionsofworking inaplacelikePegatronCorporationhasits weaknesses.Inanarticlefactsregardingthepoor conditionsofthesetitled"Apple'failingtoprotect Chinesefactoryworkers,'"theysharesomeofthe troublingtypesoffactorycommunities. [50]In2010, fourteenworkerskilledthemselvesduetothepoor livingconditionsprovidedandthenumber ofhoursworked. [51]

Insidethefacility,therearemultiplecheckpoints eachemployeemustgothroughbeforeeven beginningtowork.Metaldetectorssniffoutcamera equipmentwhilefacerecognitiondevicesverify eachemployeesaccessontotheproduction floor. The stairwells are draped with safety nets inhopesofpreventingaccidentsandsuicide attempts.Housingfacilitiesarecrampedandmold infested.Theseconditionsareunexpectable,and createinadequateplacestolive.Throughthis thesis,onecouldevaluatewaystorethinkhow housingisintegratedintomanufacturingwhilestill providingqualitylivingenvironmentsandawayto elevateindividualsstrugglingtomakeendsmeet. PerShaiOster,"thenondescriptfactoriesand sweatshopsoftheoldaregivingwaytomodern-stylecampuseswithamenitiessuchasfreeWi-Fi, televisionlounges,cleaningservicesandeven optionsforupgradeddorms." [52]

Throughthisanalysis,itisprevalentthatthe PegatronCorporation,muchlikePruitt-Igoeboth havebeendeemedasfailurestomany.Although, itisthosefailuresthatcanbereimaginedand improveduponinfutureiterationsandreinventions ofthattypology.Howcanwemodernizethe industrialage,andcreateamoresatisfyingliving andworkingenvironmentthatfacilitatesindividual growth?

47 Oster, Shai. "Inside One of the World's Most Secretive Iphone Factories." Bloomberg, 24 Apr. 2016. Accessed 25 Oct. 2016.
48 Ibid.
49 Ibid.
50 Bilton, Richard. "Apple 'failing to protect Chinese factory workers'." BBC News, BBC News, 18 Dec. 2014. Accessed 25 Oct. 2016.
51 Ibid.
52 Oster, Shai. "Inside One of the World's Most Secretive Iphone Factories." Bloomberg, 24 Apr. 2016. Accessed 25 Oct. 2016.

Image 90: Pegatron Corporation outdoor space

Image 91: Pegatron Corporation employee living space

Image 92: Employees at Pegatron await to start their shift

PRECEDENT:KPDFACTORY +PANELS

Anotherwayofperceivingthishousingsystemposed bythemixingofmanufacturingandhousing,isto thinkabouthowthehomeismanufactured.Instead ofthemanufacturingandhousingcomponentsbeing twoveryseparateprogramswecanthinkaboutways inwhichpeoplecanearnanincomebybuilding housesforthemselvesandothers.Throughout history,prefabricatedhomeswereoftentheanswerto affordablehousingbecausethecostofconstruction wasmuchlessthenhomesbuildusingtraditional woodframingmethods.

Oneexample,ofprefabricatedaffordablehousingcan befoundinChile.Constructedoutofconcrete,these mass-producedpanelsknownasKPD,aRussian acronymwhichmeans“largeconstructedpanel” wereusedtoproducemasshousingcommunities throughoutChile.Thefactoriesandengineeringof thesepanelswerefundedbytheSovietUnionand aidedChileintheirsocialhousingprogram.Inan essaytitled“APanel’sTale:TheSovietI-464System andPoliticsofAssemblage,”theauthorsstatethat factoriescouldprovideupto2,000housingunitsa year.[53] Thesepanelsweremanufacturedforcost effectivenessandspeedofconstructiontoreduce costs.Whenbroughttodifferentsiteswithin Chilethe concretepanelswouldbeassembledbyconnecting the panels with steel rod and filling the joints with pouredconcretetoproducearigidandhomogeneous whole.[54]

Although,thisprecedenthasmanymorelayerstoit inregardstopolitics,somelessonslearnedfromit includethinkingabouttheproductionofthesehomes asasystemfromthemanufacturingofapanelto theconstructionof153housingblocksinashort periodoftime. [55] Inregardstothisthesis,how mightanewhousingtypologyinsertitselfintothe systemofmanufacturingaffordablehousing.

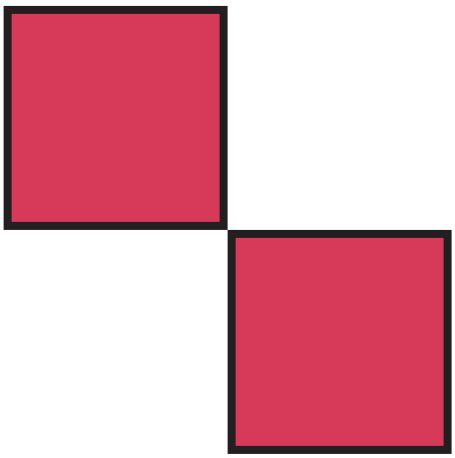


Image 93: Artwork depicting KPD panels in Latin America

53 Alonso, Pedro, and Hugo Sagredo. “A Panel’s Tale: The Soviet I-464 System and the Politics of Assemblage.” Latin American Modern Architectures: Ambiguous Territories, edited by Patricio del Real and Helen Gyger, New York, Routledge, 2013, pp. 154.

54 Ibid., 154.

55 Ibid., 159.

Image 94: Construction using KPD panels

Image 95: 1972 President Allende signs a wet HC1N wall panel

Image 96: KPD panel at the factory entrance

APPENDIX C: THESIS PREP

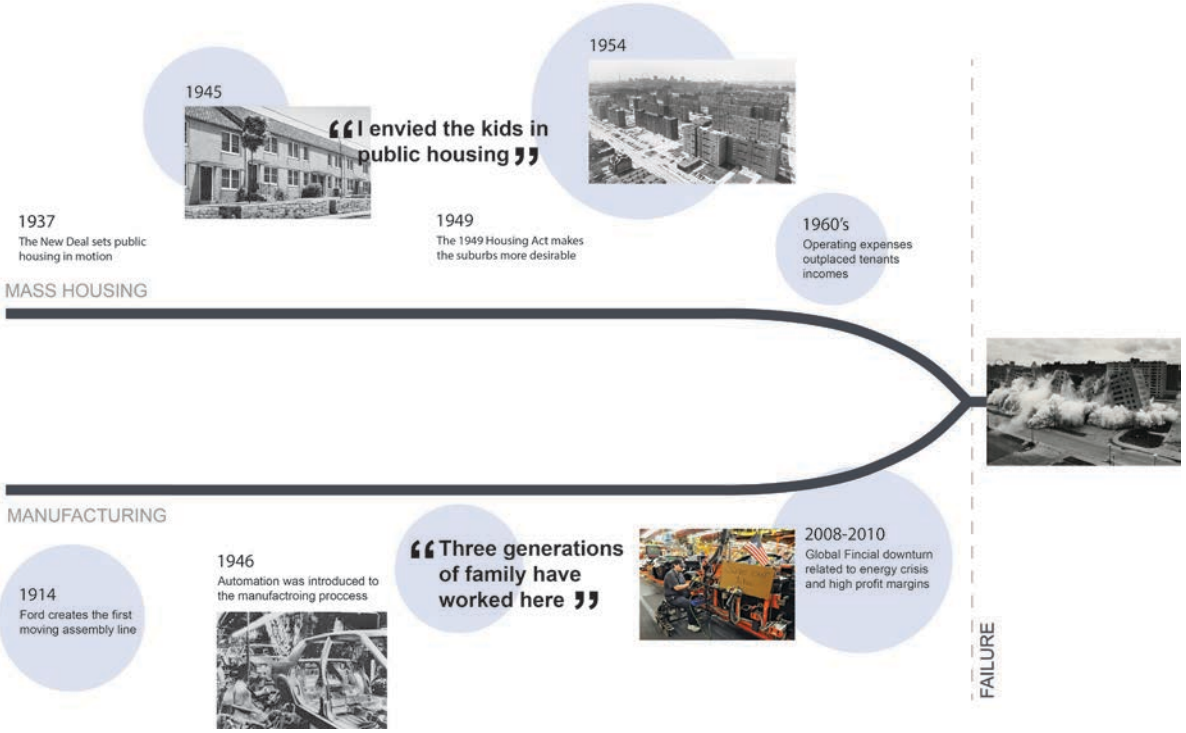


Image 97: Housing and manufacturing failure timeline

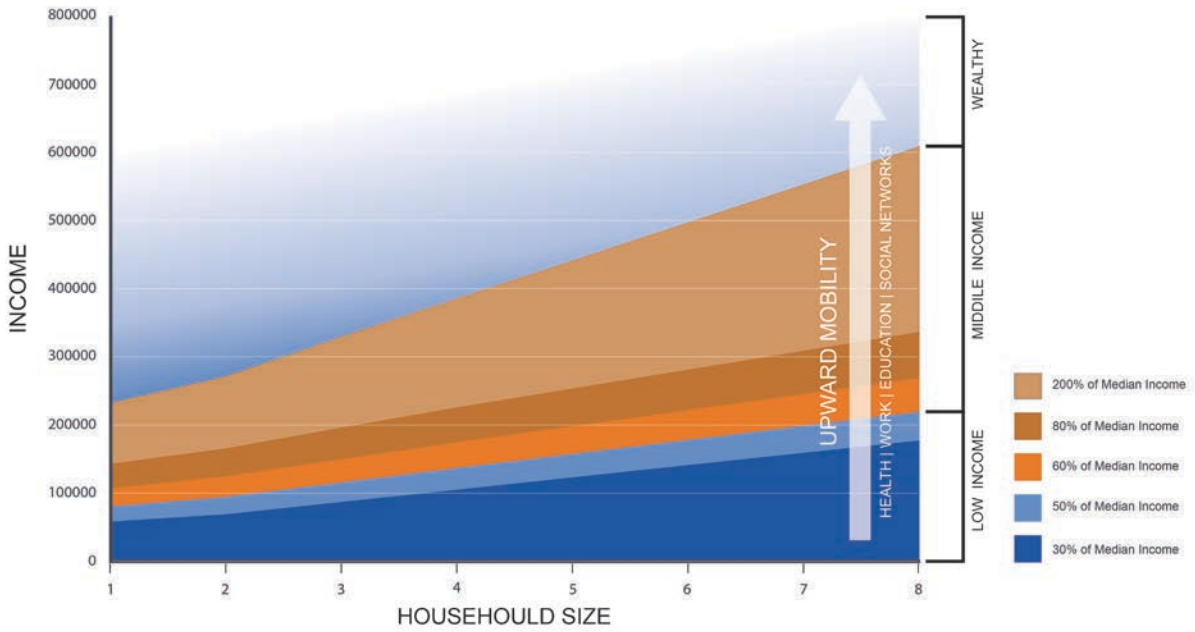


Image 98: Socioeconomic breakdown

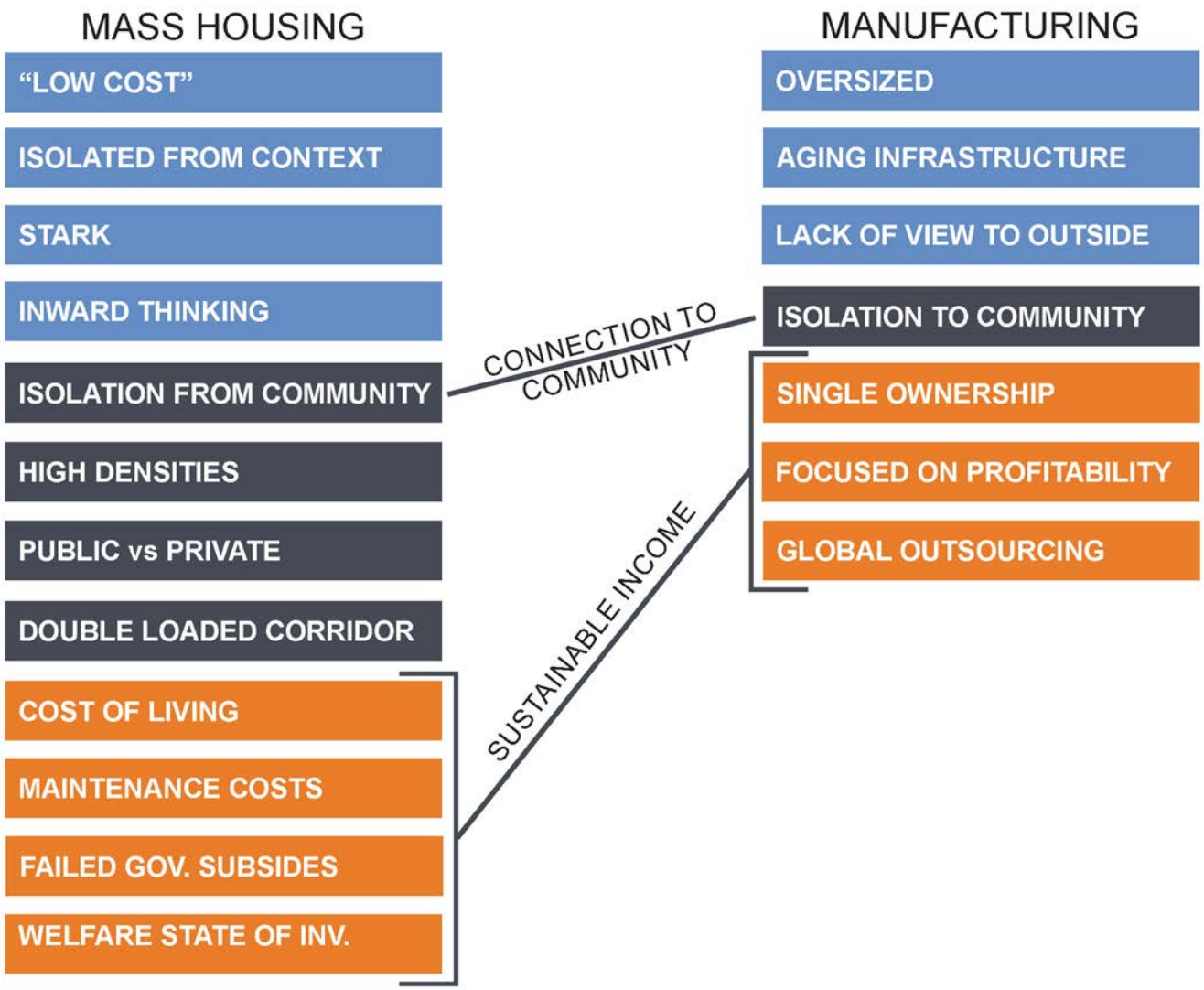


Image 99: Reasons for failure in manufacturing and housing

HOUSING NEED

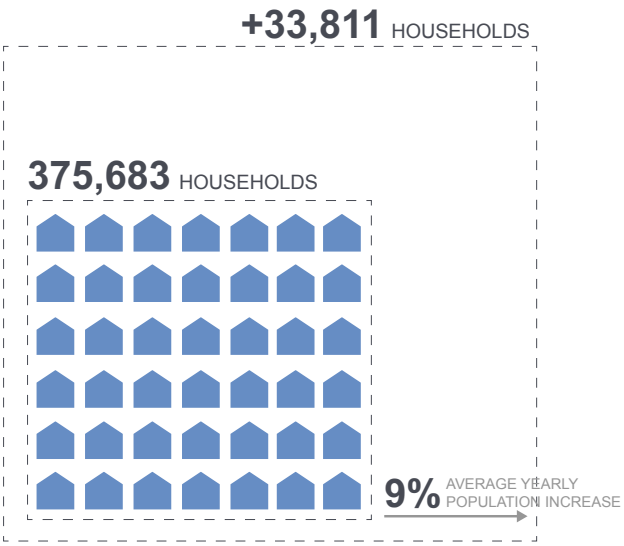


Image 100: Housing need in Grand Rapids Metro diagram

NEED FOR SKILLED WORKERS

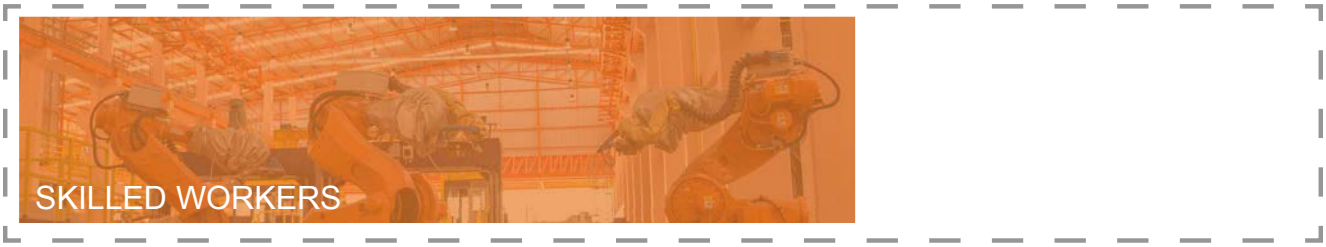


Image 101: Need for skilled workers diagram

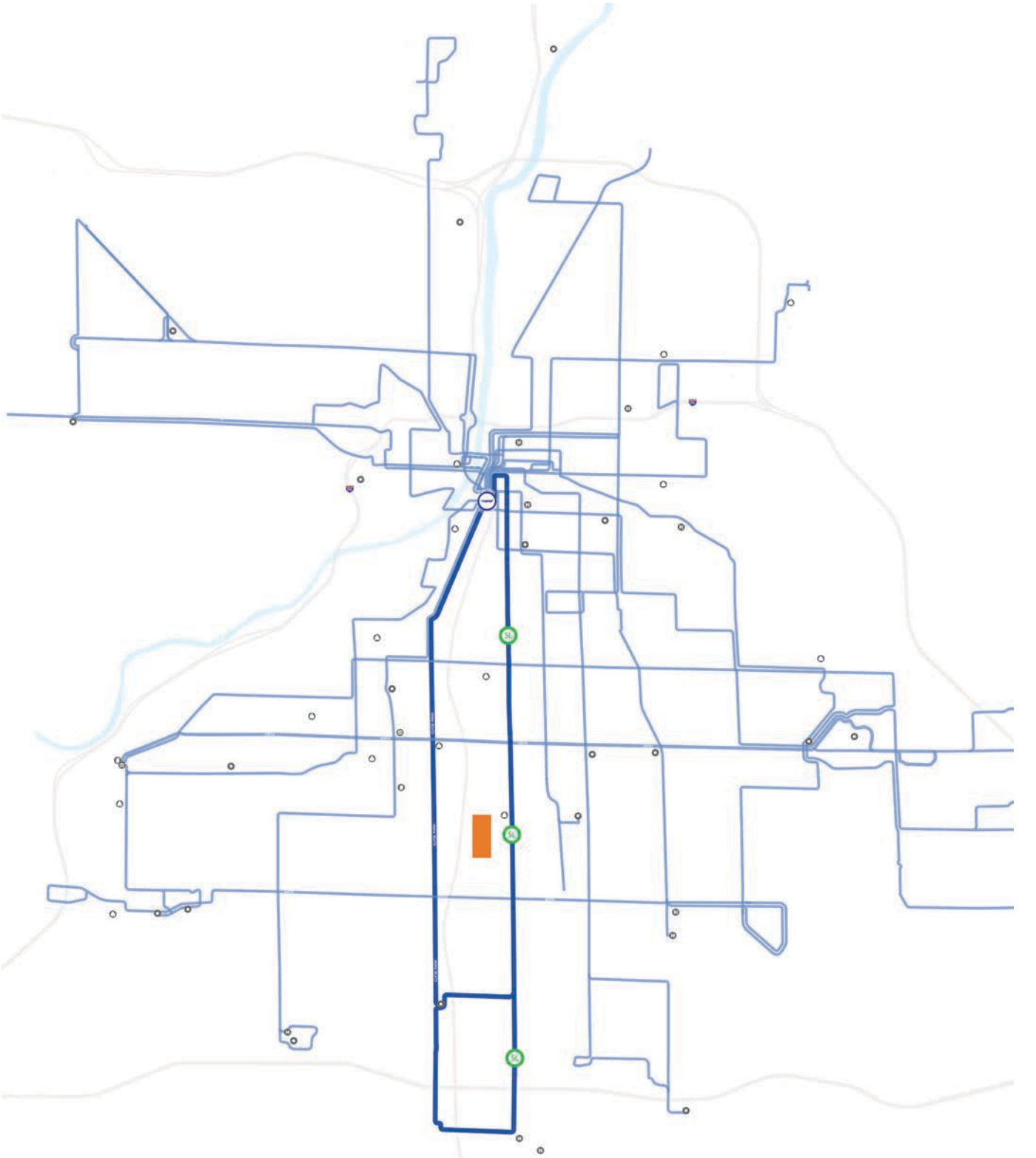
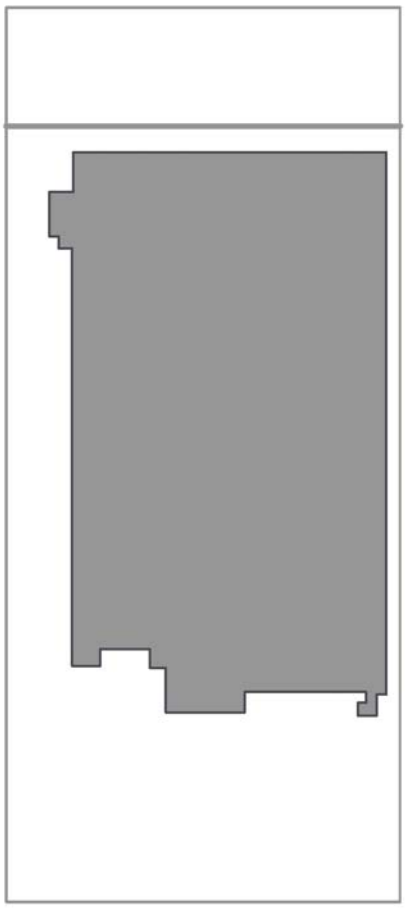


Image 102: Transit diagram

AVERAGE HOME SIZE

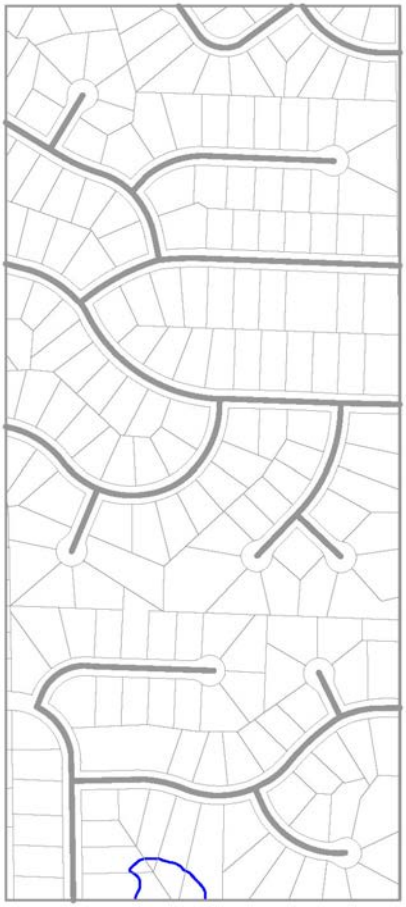
13,000 Square Feet
3 Bed



GM STAMPING PLANT

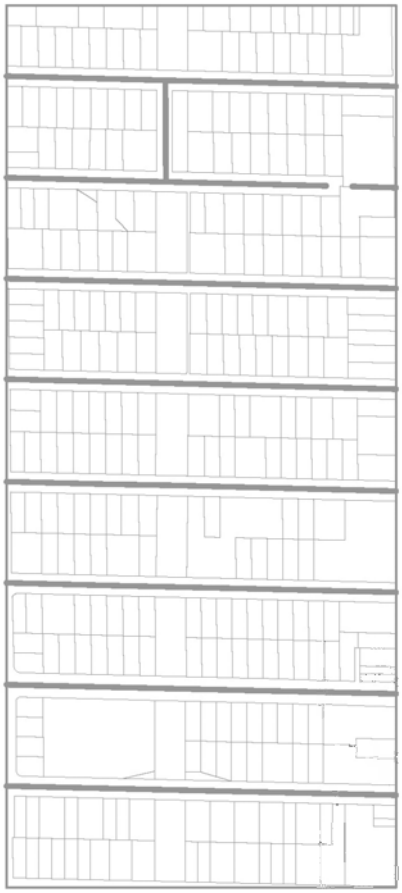
1500 Employees

Image 103: Godwin Heights neighborhood homes



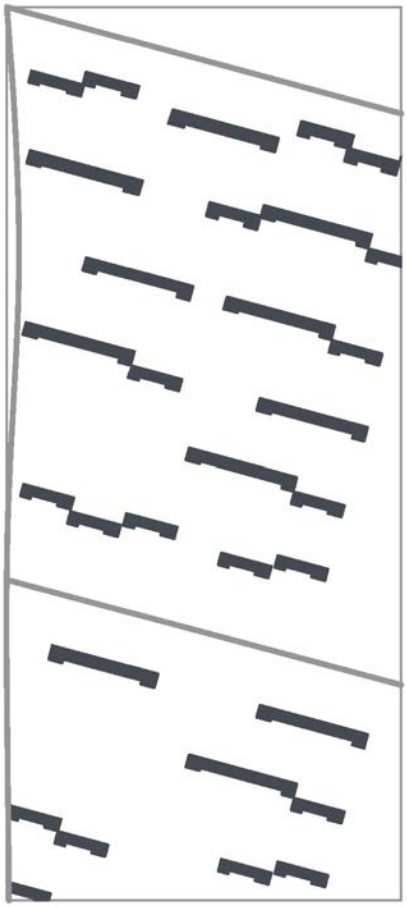
LOCAL SUBURBAN NEIGHBORHOOD

1 Home per Acre



ADJACENT NEIGHBORHOOD

5 Homes per Acre

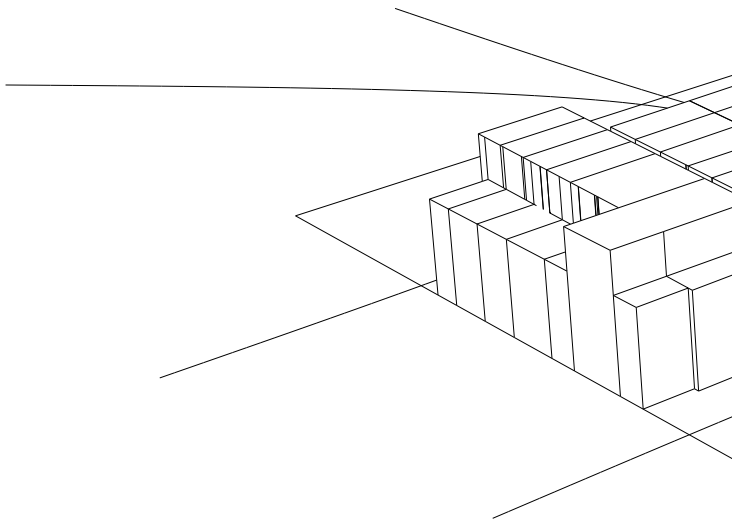


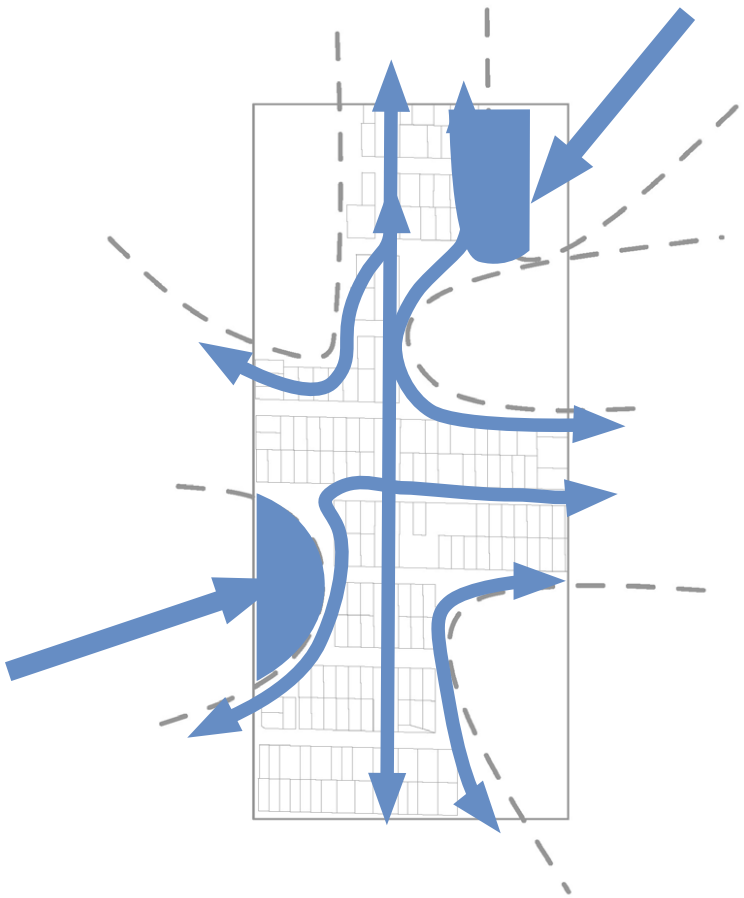
PRUITT IGOE

50 Units per Acre

Image 104: Homes per acre in different neighborhoods


200 Housing Units
3 Advanced Manufacturing
20 Acres of Landscape w/ Outdo





oor Performance and Recreation

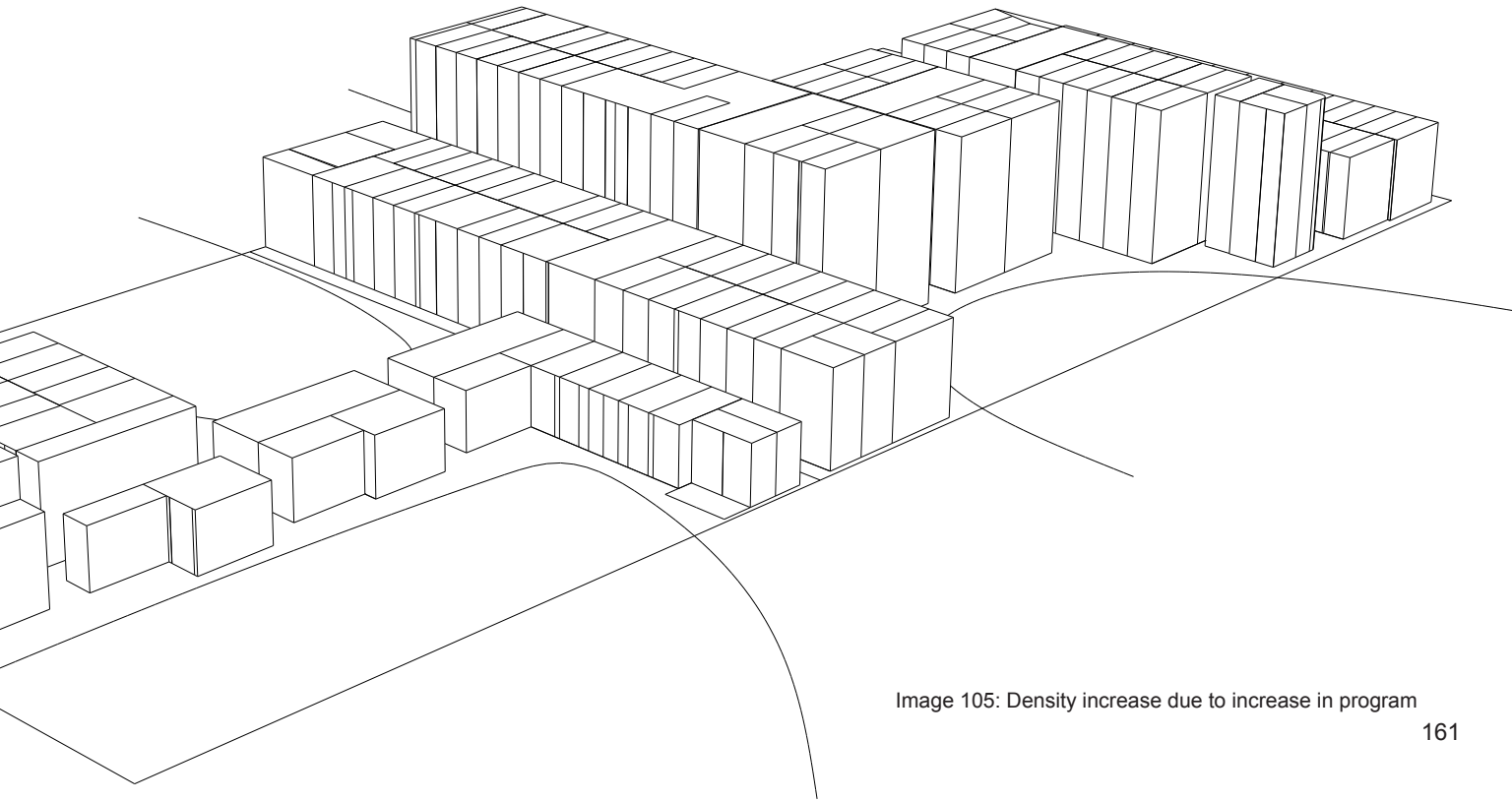


Image 105: Density increase due to increase in program

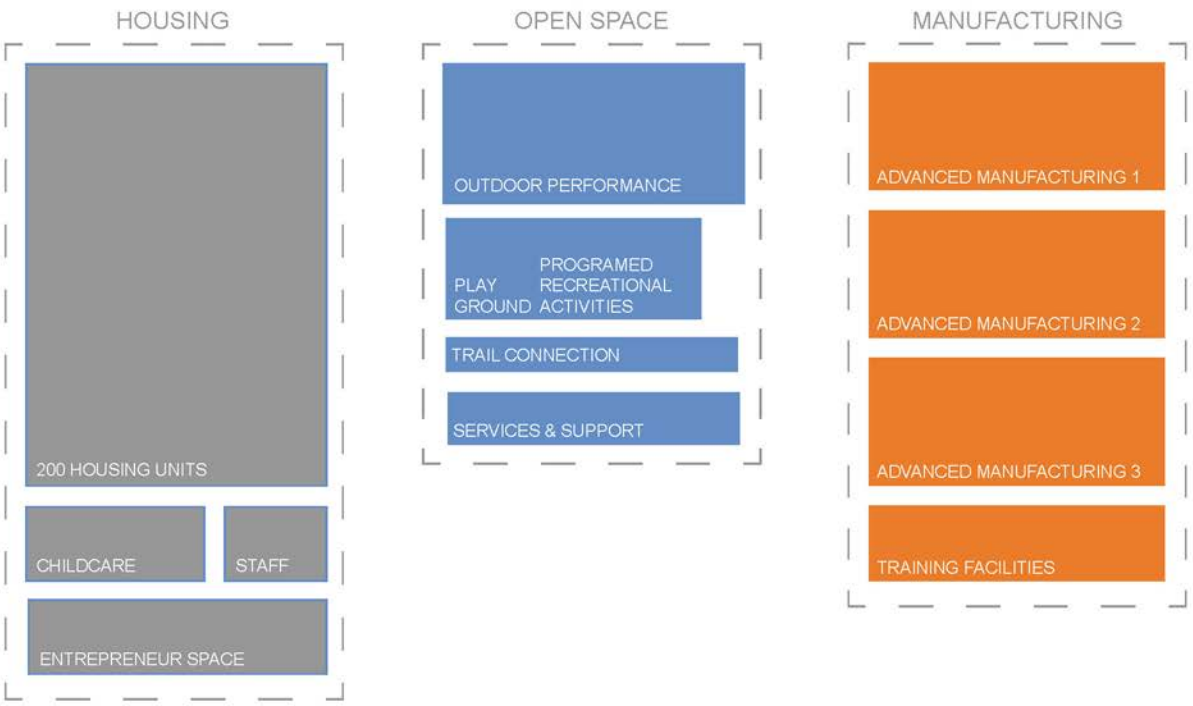


Image 106: Program elements diagram

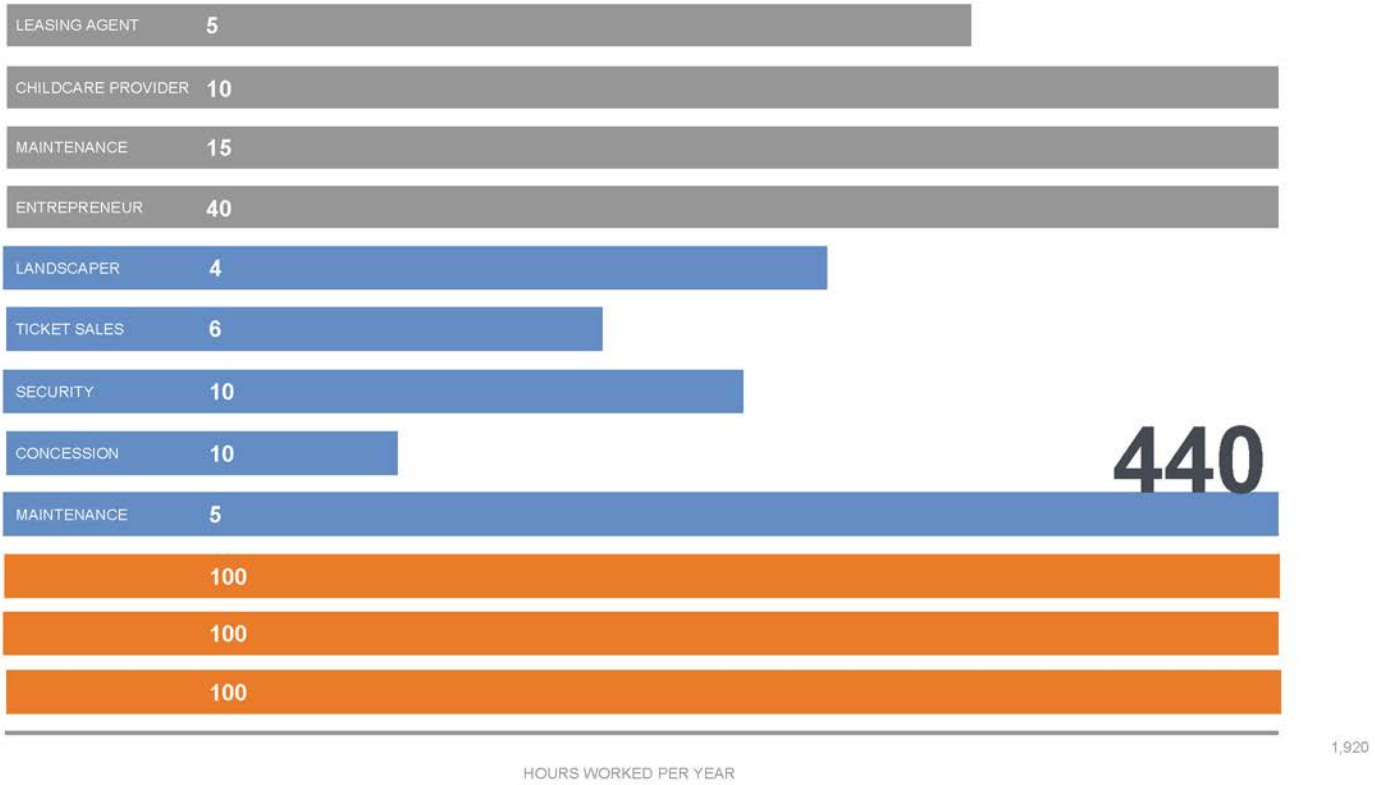


Image 107: Number of jobs provided on site

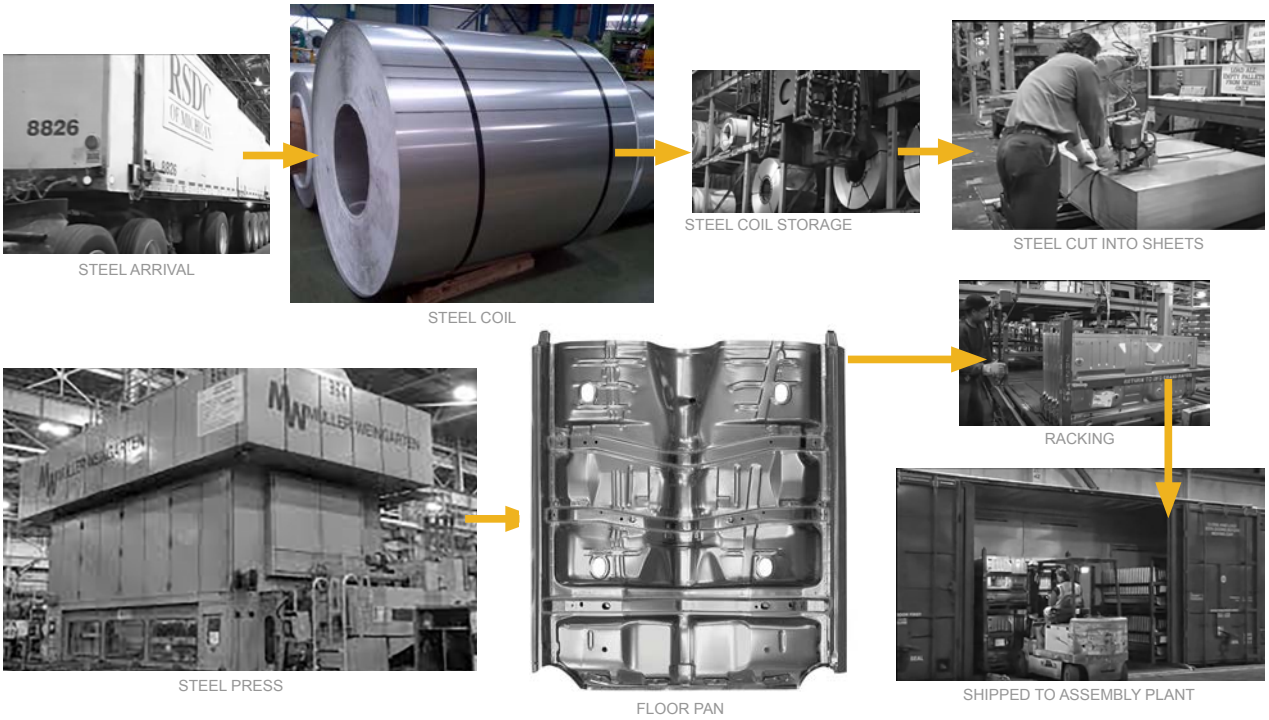
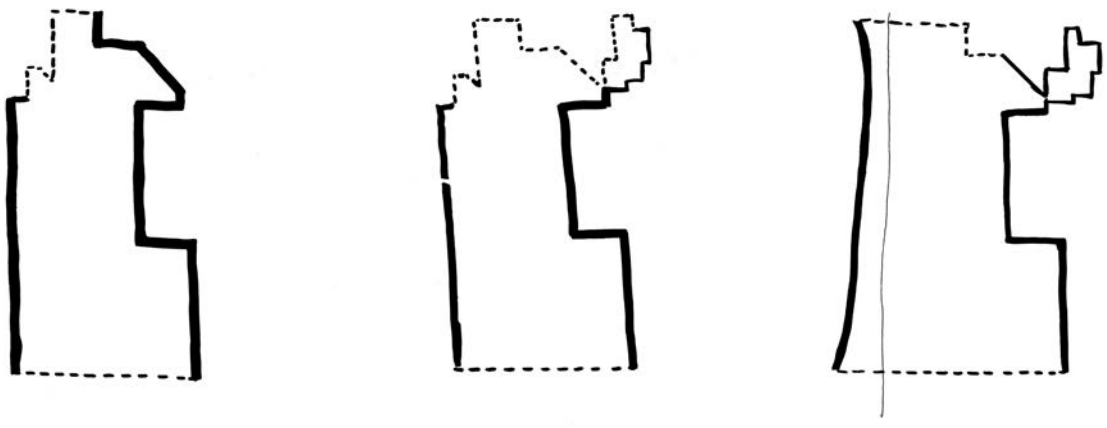
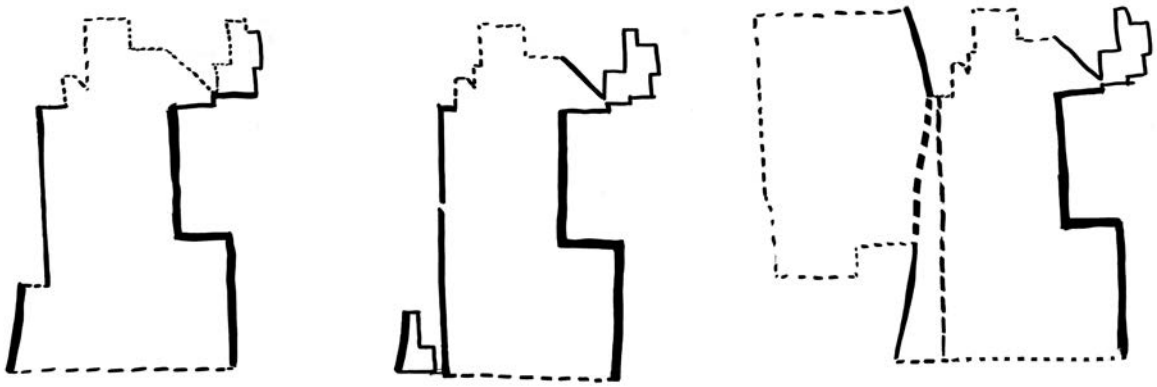
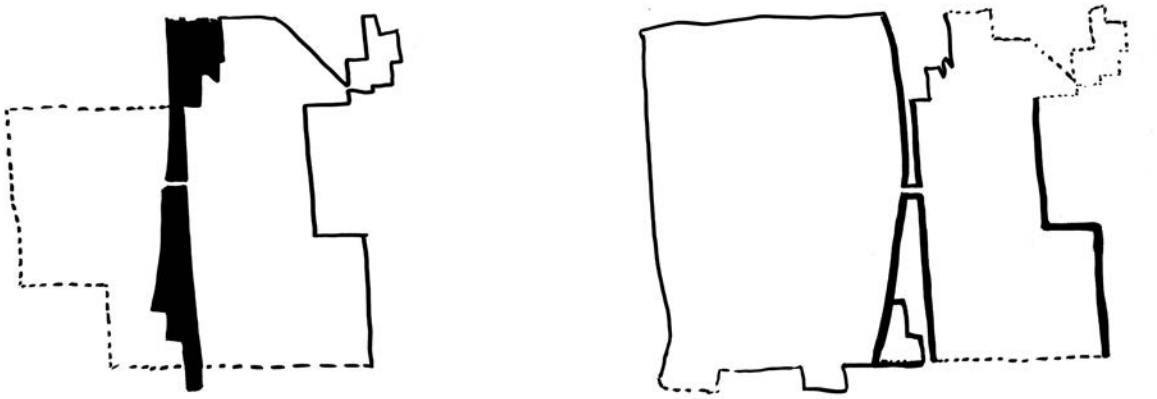


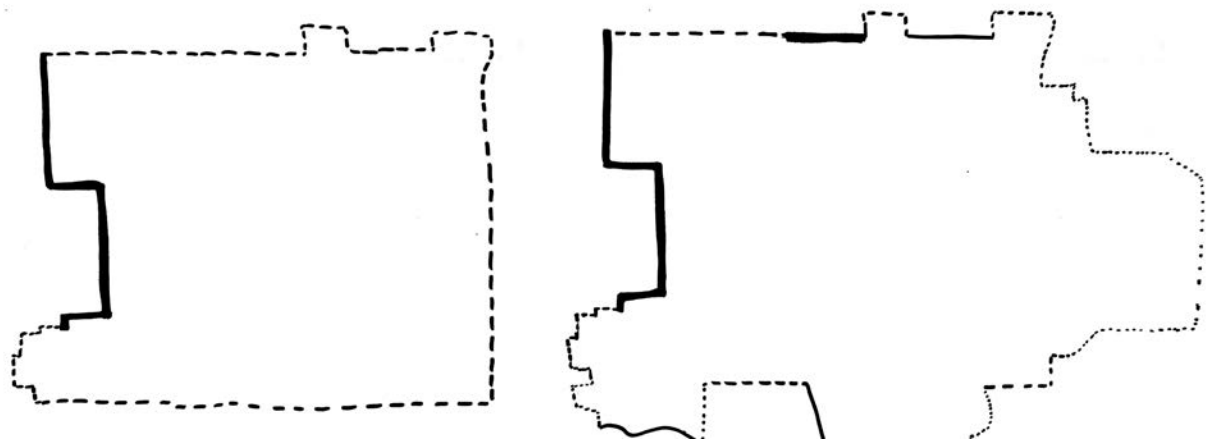
Image 108: General Motors Metal Stamping Plant process

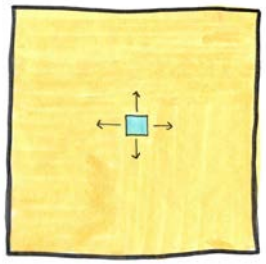
APPENDIX D: PROCESS WORK





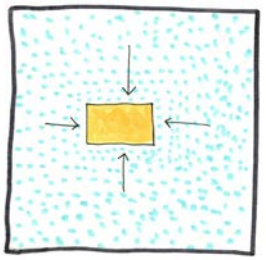






WORK = VAST FARM FIELDS
LIVE = SINGLE FAMILY HOMES

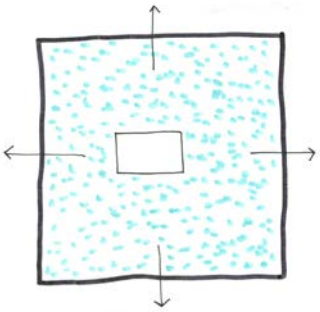
LIVE
WORK



WORK = INTENSE HARD FACTORY WORK
LIVE = SINGLE FAMILY HOUSES

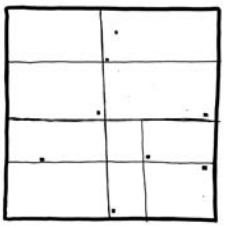
LIVE
WORK

PAST



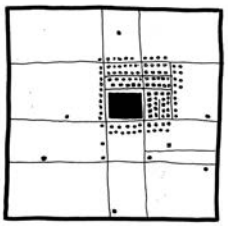
WORK = ELSEWHERE OUTSIDE OF COMMUNITY
LIVE = SINGLE FAMILY HOUSES

PRESENT



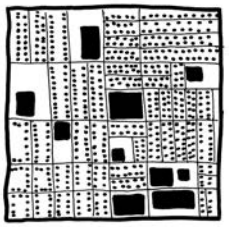
SUBURBS PRE INDUSTRY

PAST



"NEW"?
SUBURBS W/ INDUSTRY (INTEG)

PAST

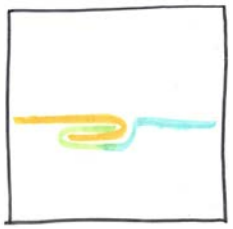


SUBURBS W/ INDUSTRIAL BOOM

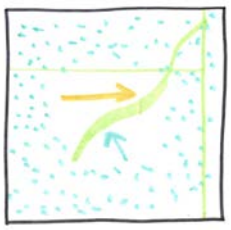
PAST

SUBURBS POST INDUSTRIAL ERA

PRESENT

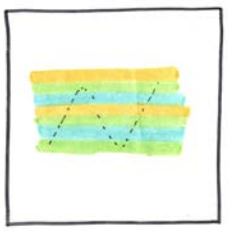


WRAPPING | HUMMING | INNERDWELL



3RD SPACE IS CENTRAL (CONNECTS TO EXISTING NEIGHBORHOOD INFRASTRUCTURE)
LIVE WORK PUSHES + PULLS IT
WEAVES - FLOWS THROUGH

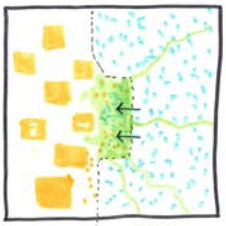
WHERE THEY INTERSECT
PUSH PULL EACHOTHER



LAYERS
THINGS / ACTIVITIES WEAVE BACK + FORTH

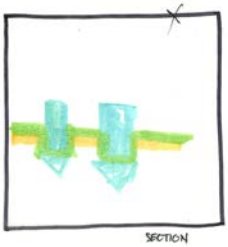
→ IF FAILURE

WORK STAYS ON SITE BUT ALSO DRAWS PEOPLE INTO SITE FOR WORK / COMMUNITY PROGRAMS



PLAN

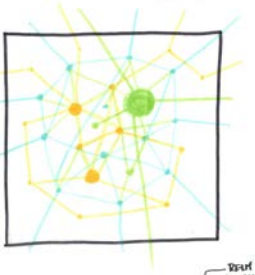
EXISTING INDUSTRIAL BOUNDARY



SECTION

REMOVE THROUGH INDUSTRY

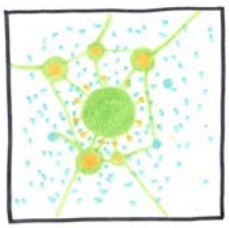
HOUSING / LIVING BRINGS TO INSERT ITSELF BACK INTO AREAS THAT HAVE CAUSED SEPERATION / HOLES IN THE EXISTING FABRIC AND THEN [illegible]

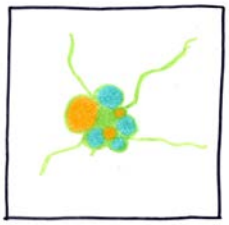


NETWORK OF DECENTRALIZED FACTORIES / SMART MANUFACTURING COLLABORATION

ALL 3 SPACES ARE INTER CONNECTED

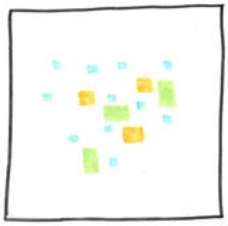
RELY ON ONE ANOTHER IF ONE FAILS IT IS ABSORBED OR TRANSFORMED BY ANOTHER





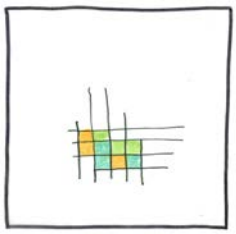
3RD SPACE CONNECTORS
↳ CENTRAL

HOW IS IT THAT IF INDUSTRY FAILS THE [illegible]



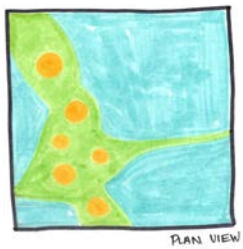
DECENTRALIZE
-BREAK DOWN INTO SMALLER [illegible]

WORK
LIVE
3RD SPACE / SHARED



HOW DOES IT REMAIN FLEXABLE
PLUG + PLAY TETRIS (SP?)

SECTION

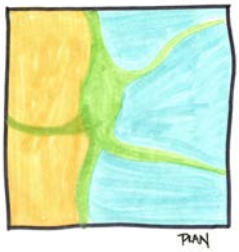


PLAN VIEW

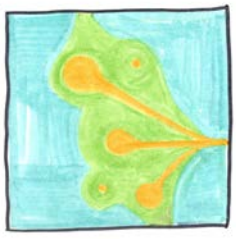
NEMBRAIN

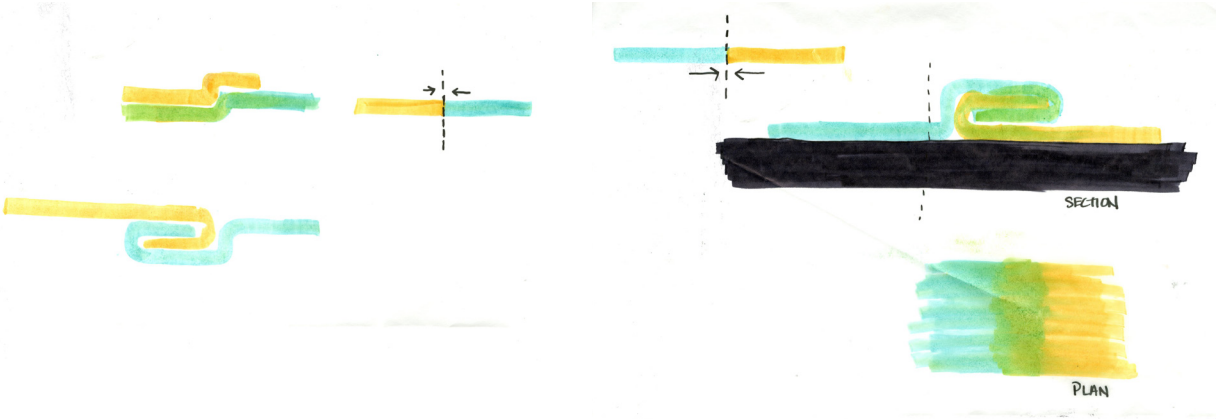
1 FIELD OF LIVING IMPACTED BY SHARED SPACE WHICH (PROTECTS) ACTS AS A BOUNDRY (NUMBRAIN) THAT SURROUNDS INDUSTRY

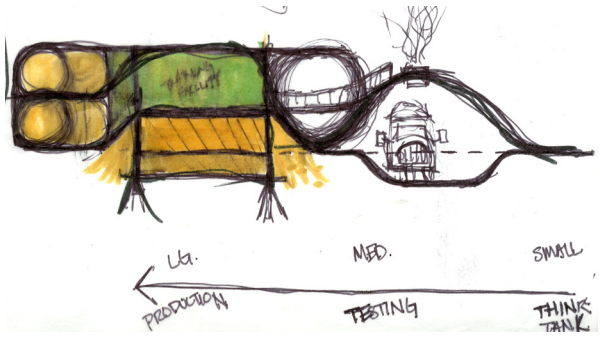
PLAN VIEW
↳ LAYERS
2. FIELDS COMING TOGETHER → CREATE NEW OBJECT?

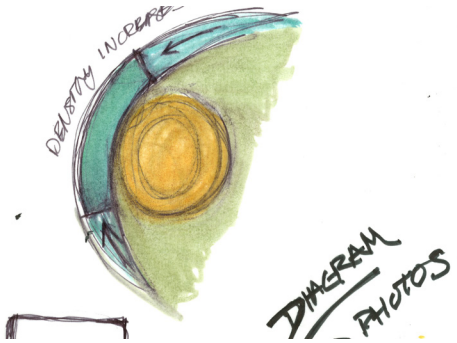


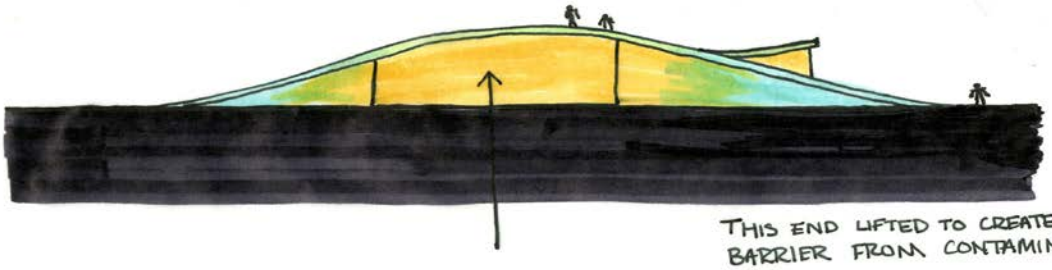
PLAN

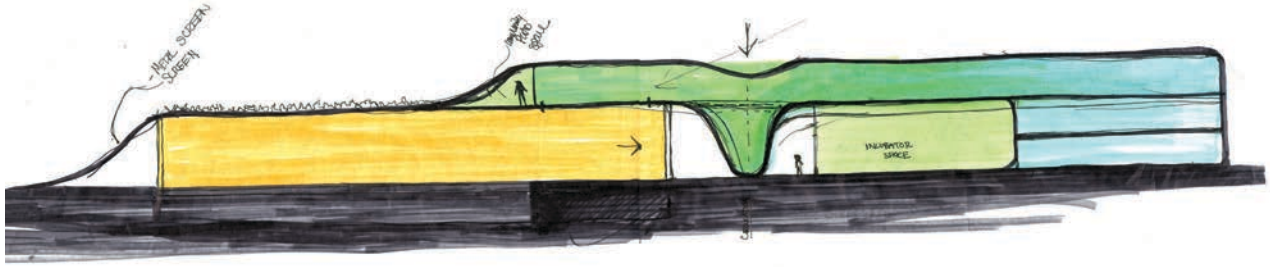


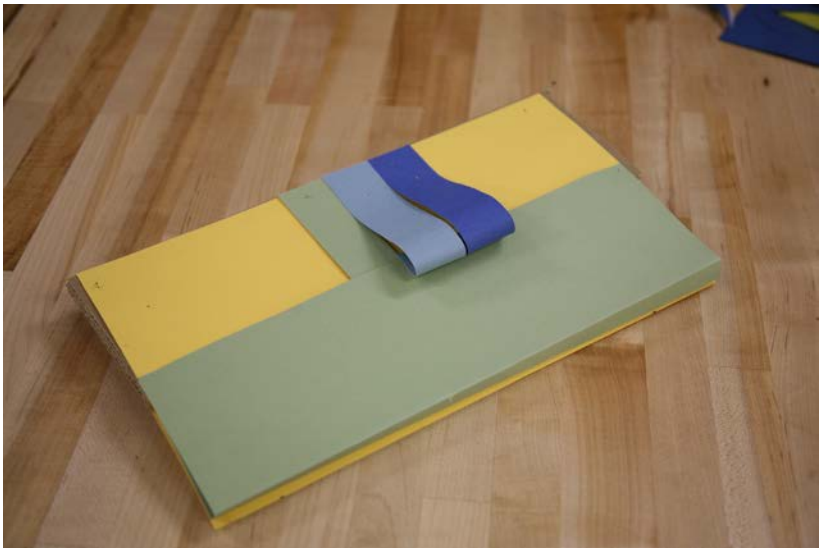

SECTION
PLAN

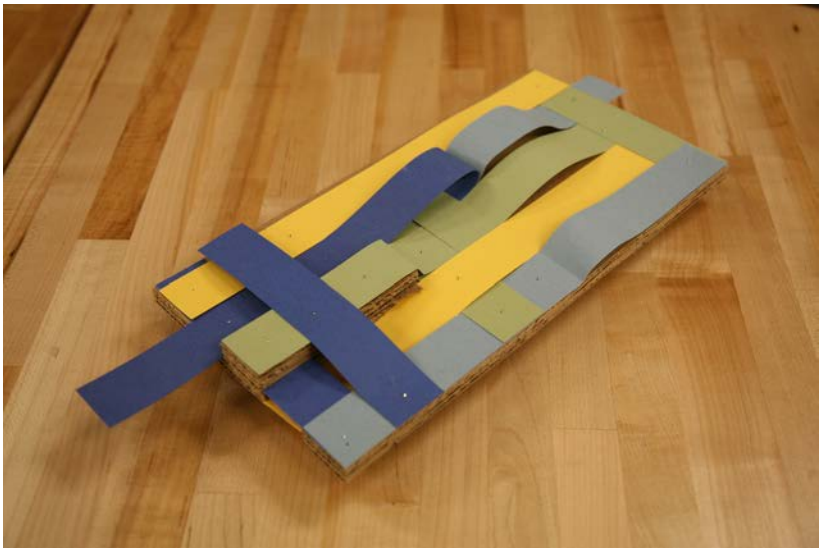

LG.
MED.
SMALL
PRODUCTION
TESTING
THINK TANK

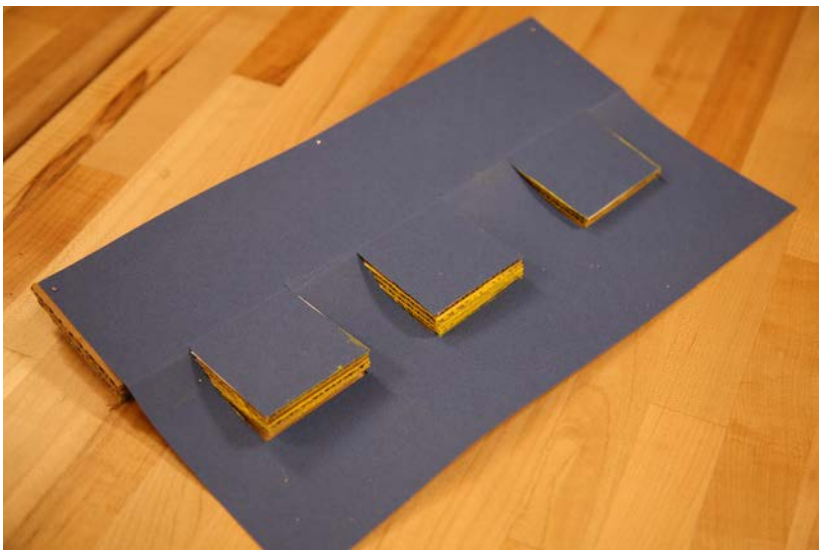

DENSITY INCREASE
DIAGRAM PHOTOS

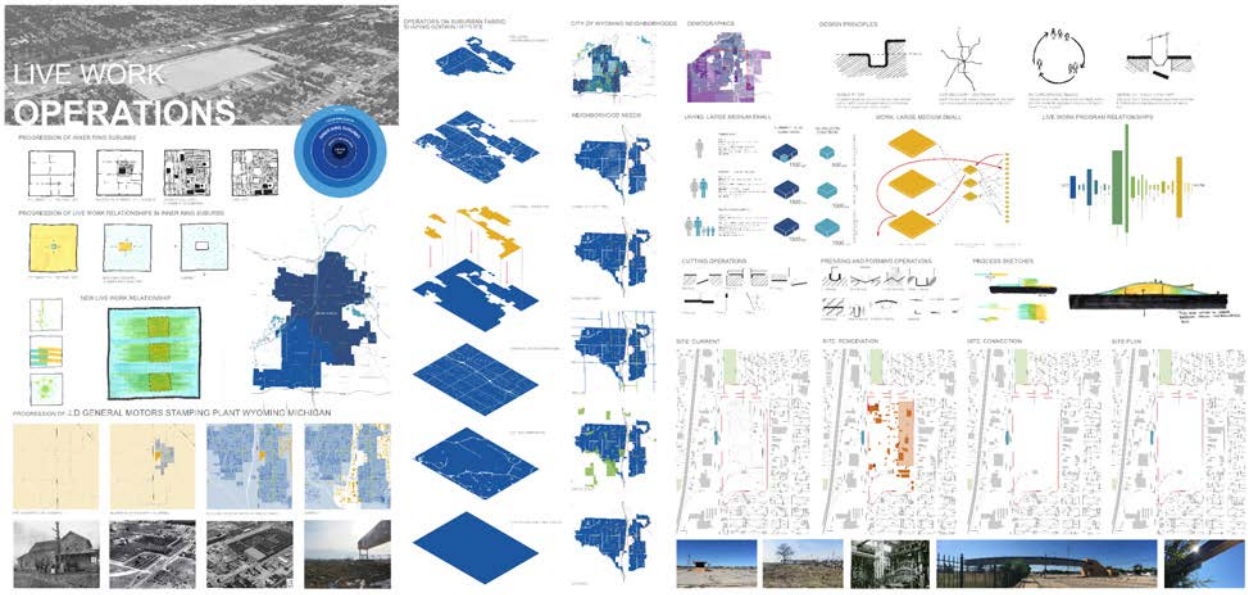

THIS END LIFTED TO CREATE BARRIER FROM CONTAMINATED SOIL

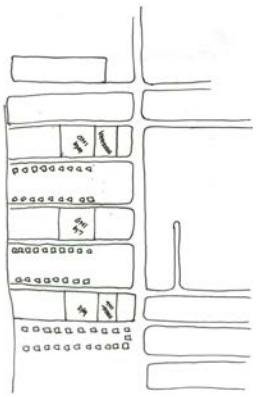

INCUBATOR SPACE

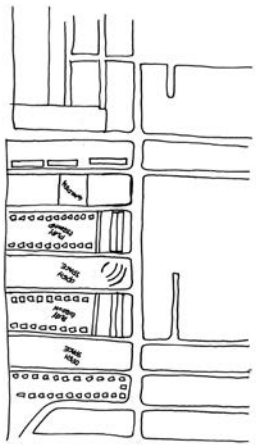


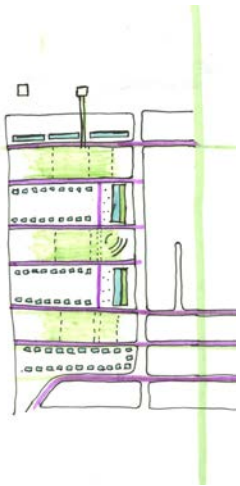


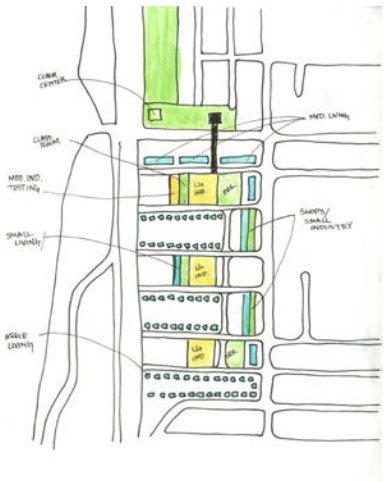


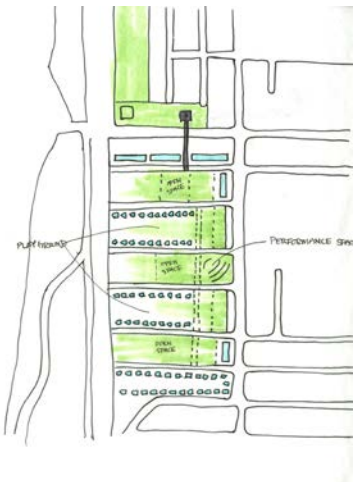

LIVE WORK
OPERATIONS

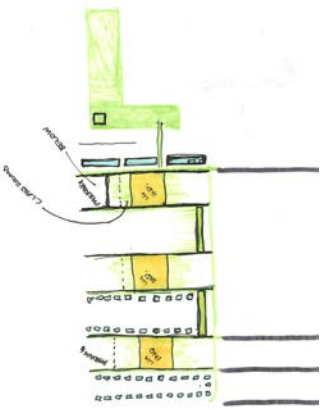


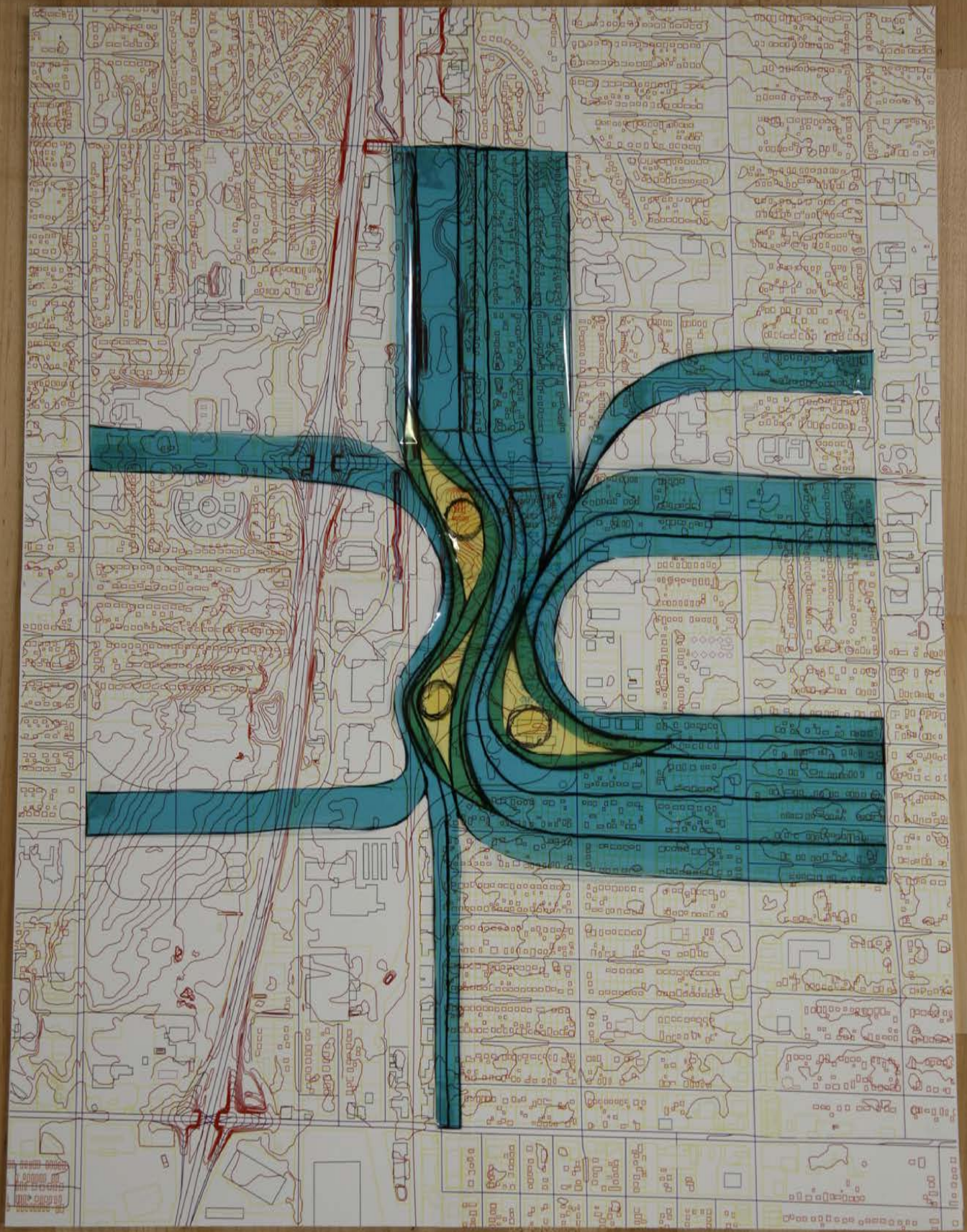


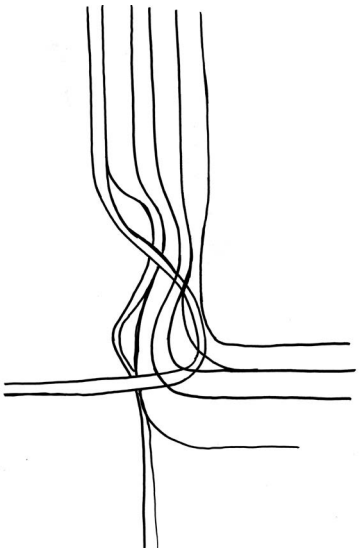


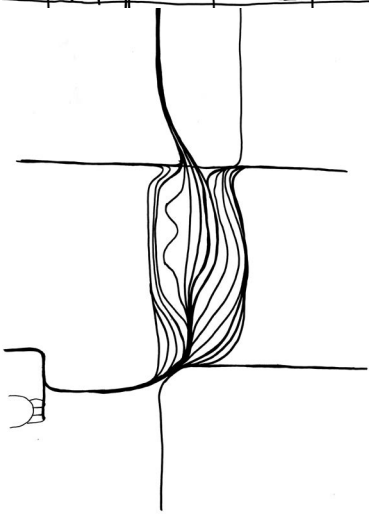


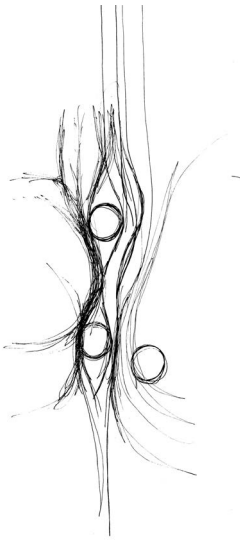
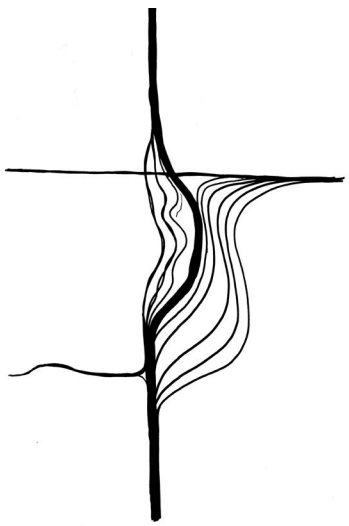


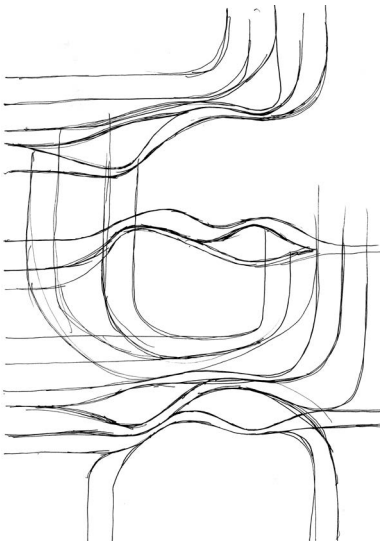


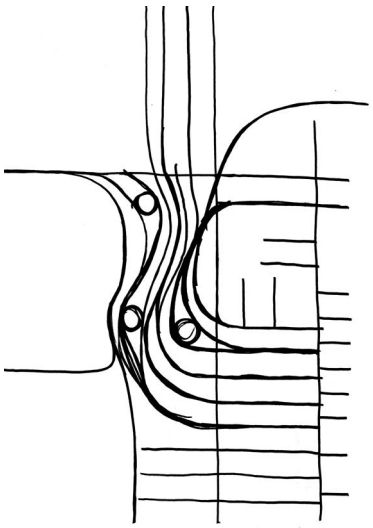


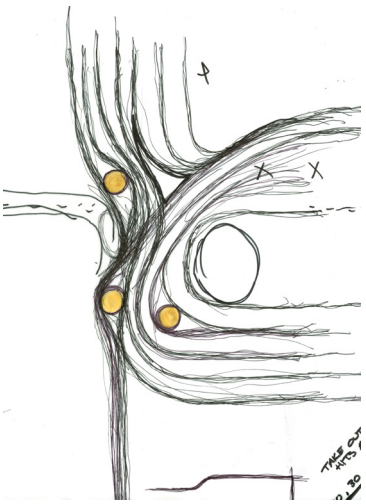



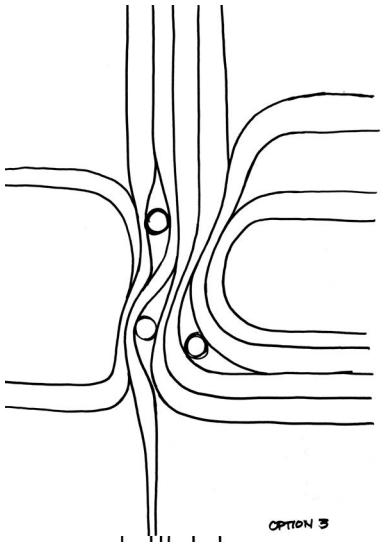


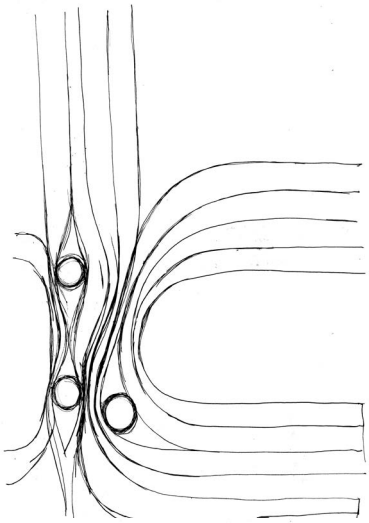



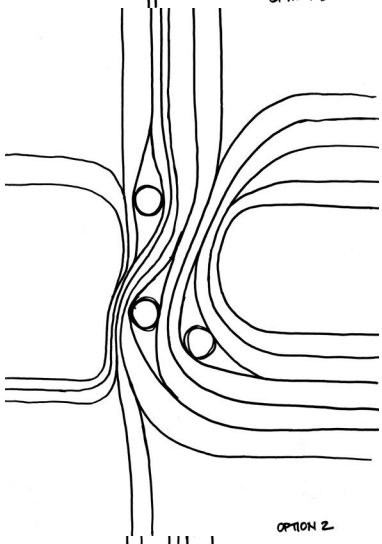


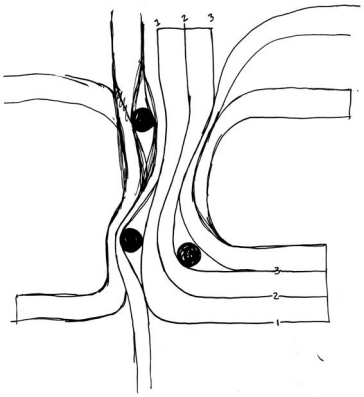




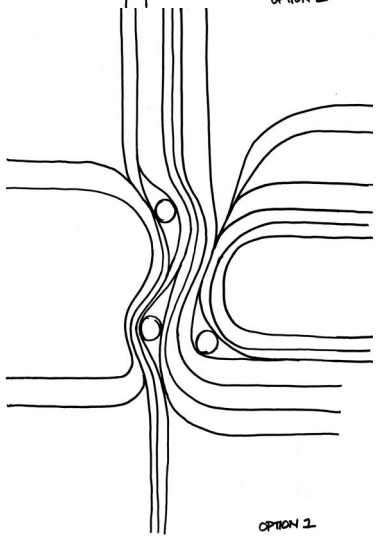

OPTION 3

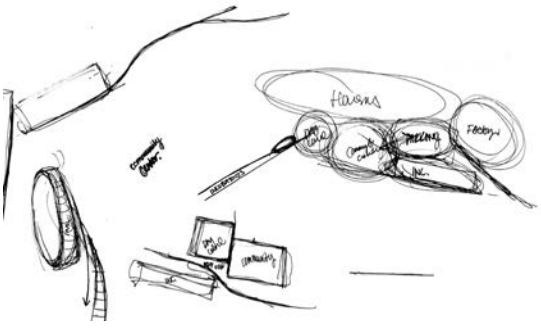


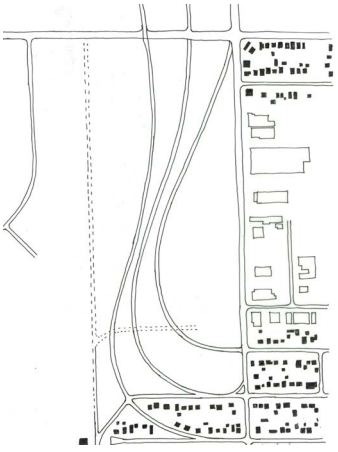

OPTION 2

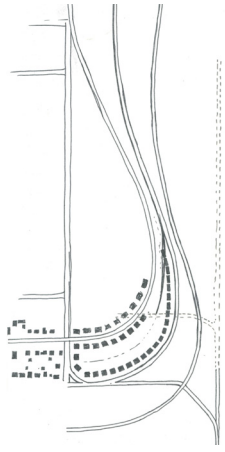

1
2
3
3
2
1

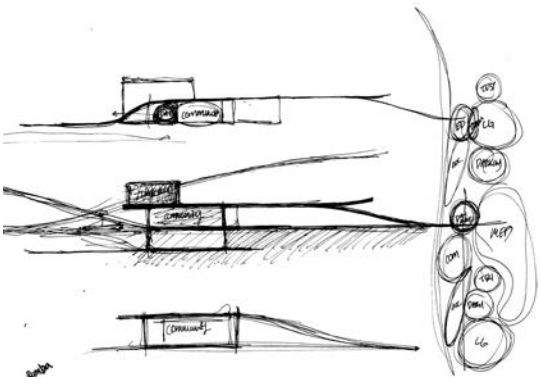

Y→ Us

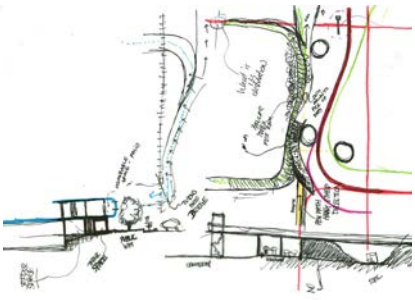

OPTION 1

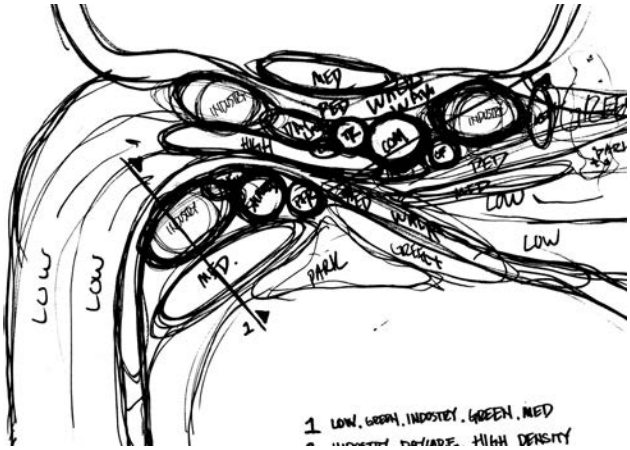

Houses

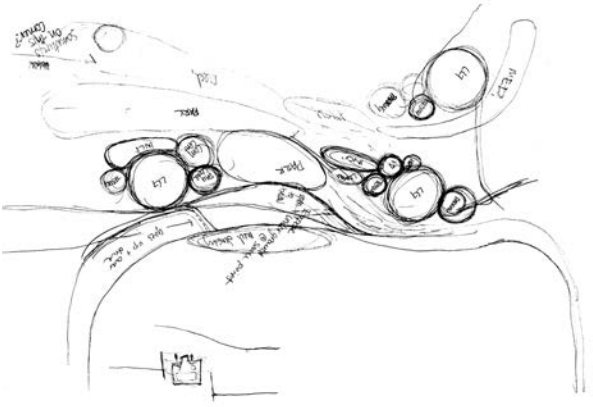


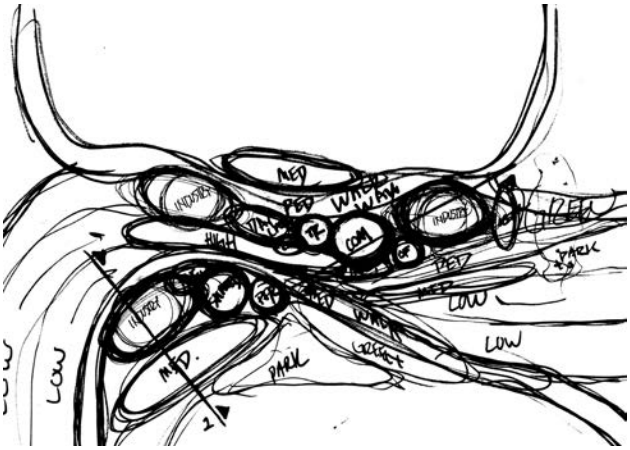


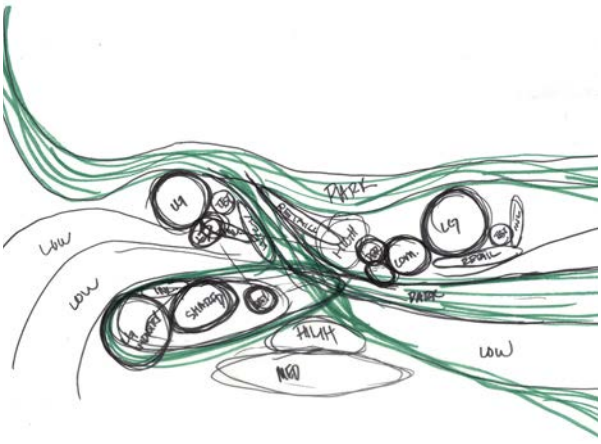


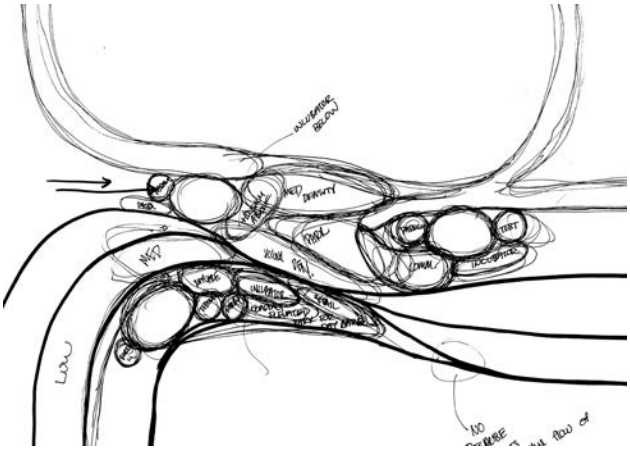


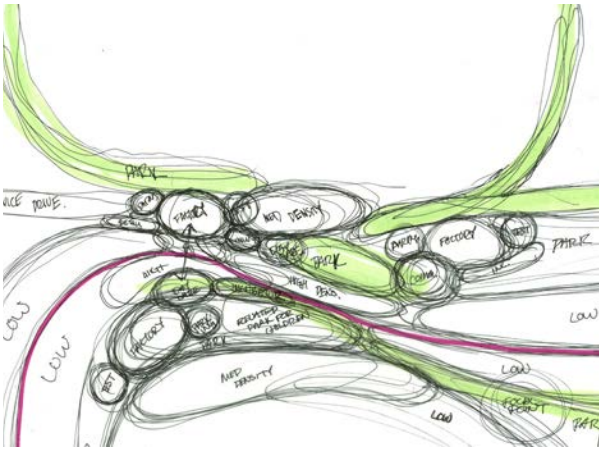

1 LOW. GREEN. INDUSTRY. GREEN. MED

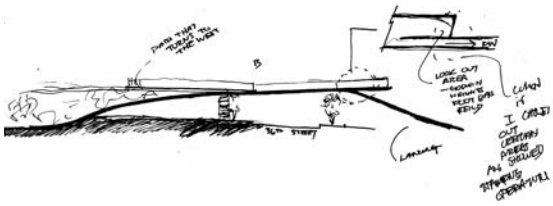






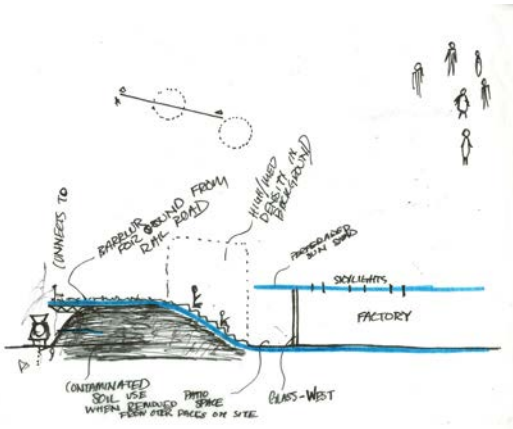


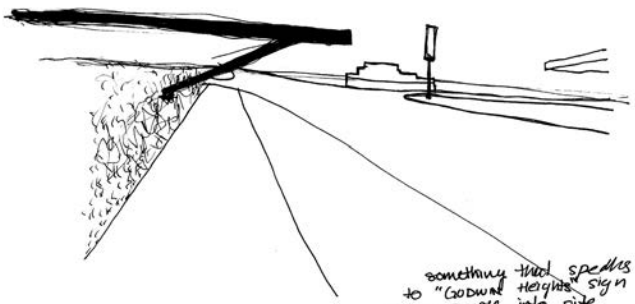


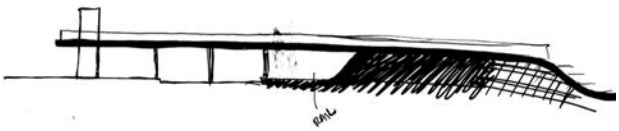

LOOK OUT AREA
LOOK OUT CANTILEVER PIERS REQUIRED AS STRUCTURAL OPERATION

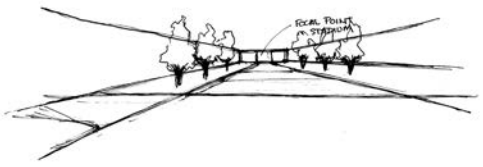

= LIVING
= STREET
N
THIS FAÇADE CREATES A WALL AS IT PEELS OFF OF STREET + PARKING SLOPES DOWN
FACTORY
OUTDOOR SPACE
SERVICE DRIVE BELOW MAY BE OPPORTUNITY TO EXPLORE

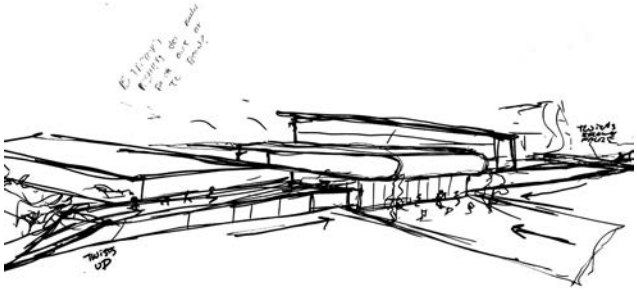

some sort of connection ACROSS RAIL ROADS

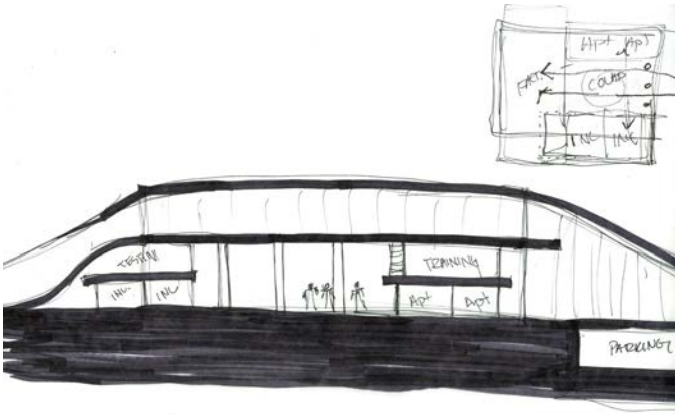

CONNECTS TO
BARRIER BEHIND FROM RAIL ROAD
HIGH LINED DESK AT (N BALCONY)
PREFABRICATED BRIDGE
SKYLIGHTS
FACTORY
CONTAMINATED SOIL USE WHERE REQUIRED
PATIO SPACE
GLASS-WEST

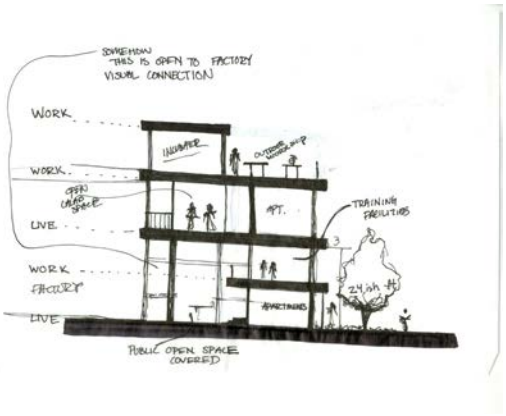

something that speaks to "Godwin Heights" sign draws people into site.

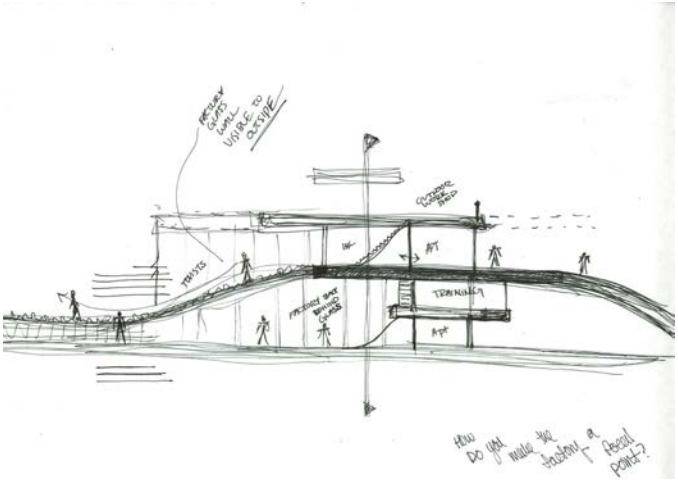

RAIL

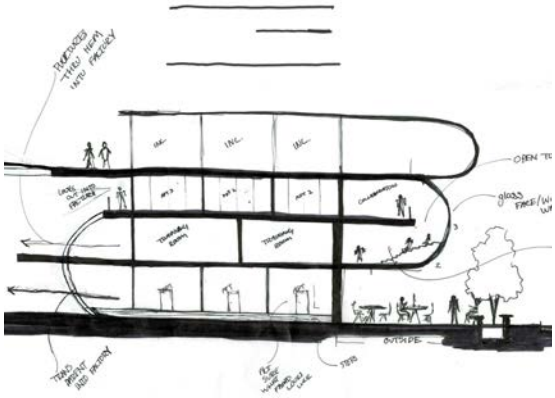

FOCAL POINT
PULLS site towards it
USE STADIUM AS ONE FOCAL POINT
- ITS A LARGE PART OF THE COMMUNITY

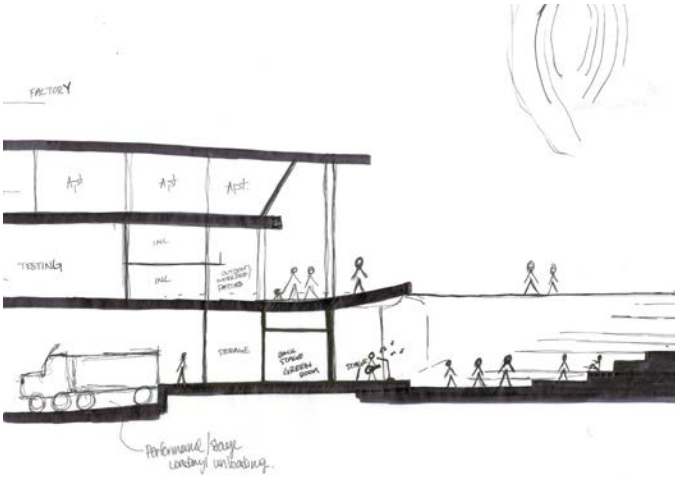

TRAIN'S ARRIVE
TRAINS UP

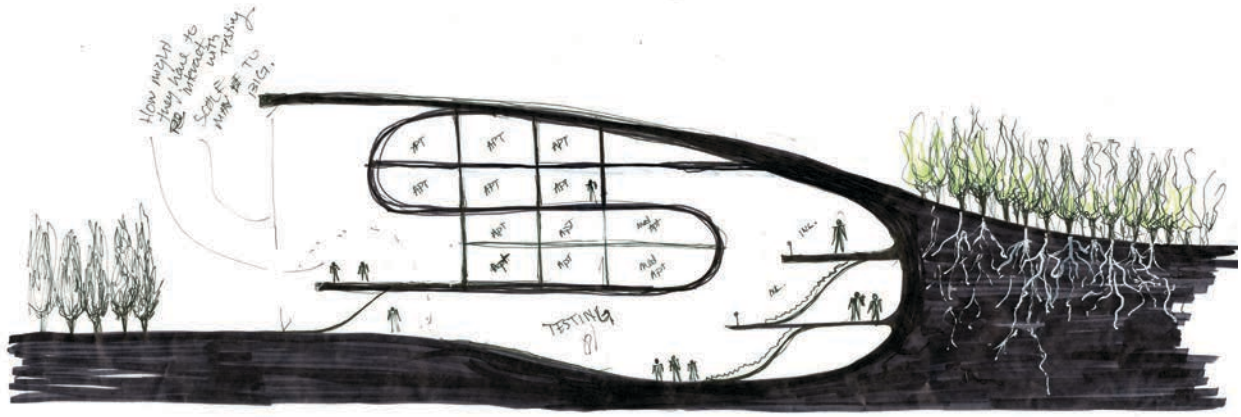

APT
APT
COURT
FACT
INC
INC
TESTING
TRAINING
APT
APT
PARKING

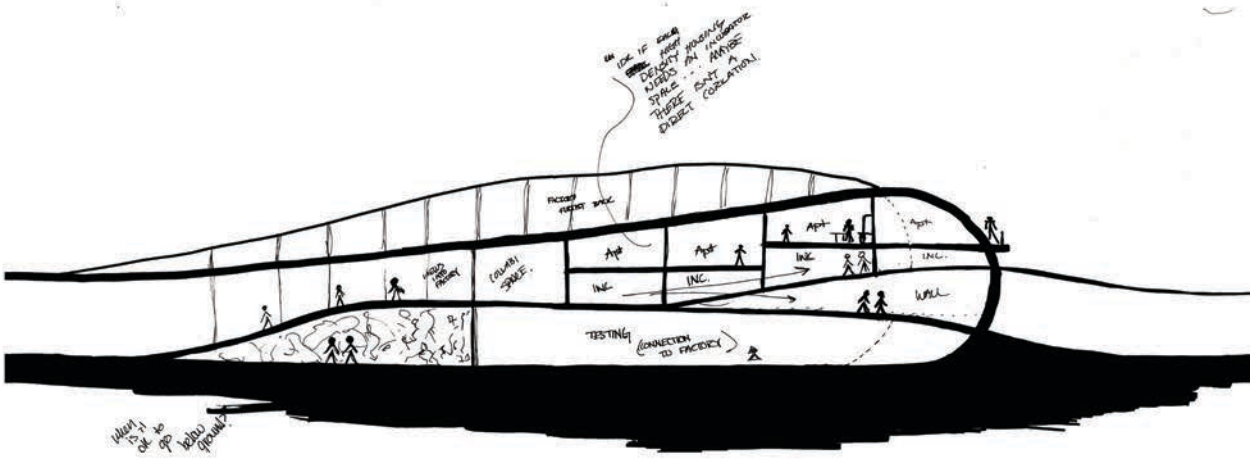

SOMEHOW
THIS IS OPEN TO FACTORY
VISUAL CONNECTION
WORK
WORK
OPEN AIR GAMES SPACE
LIVE
WORK
FACTORY
LIVE
APT.
TRAINING FACILITIES
APARTMENTS
24 wh
PUBLIC OPEN SPACE COVERED

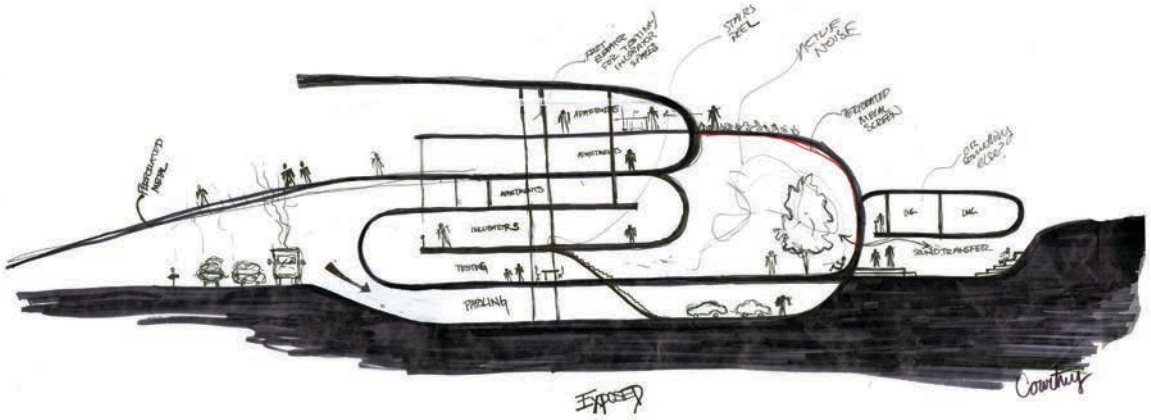

INC
APT
TRAINING
APT
How do you make the factory a focal point?

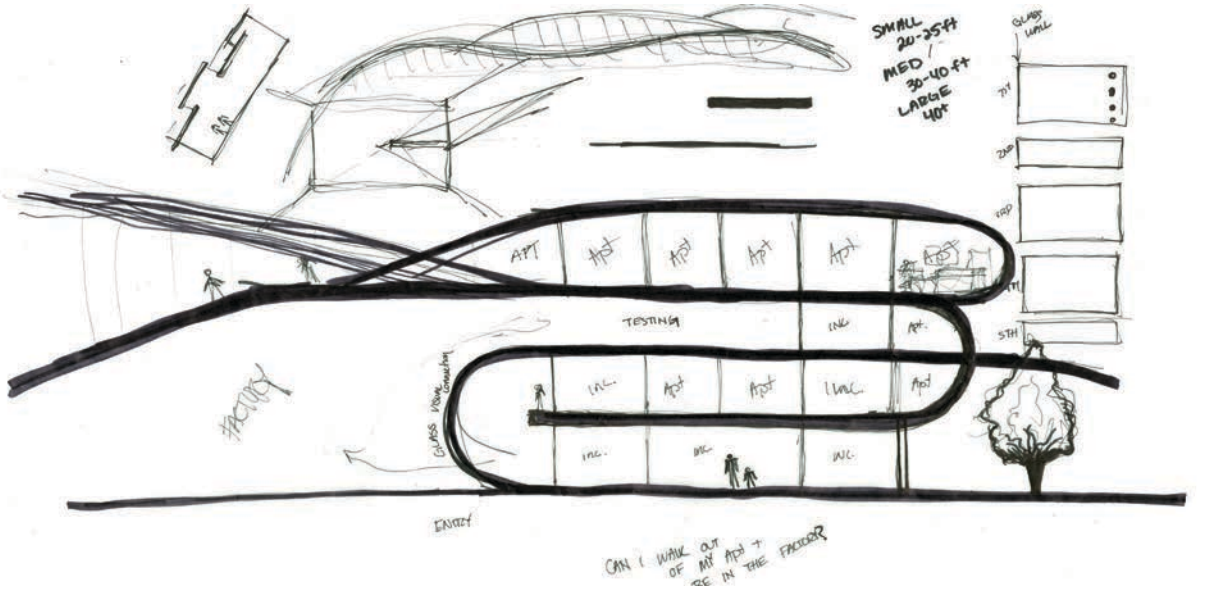

INC
INC
INC
OUTSIDE

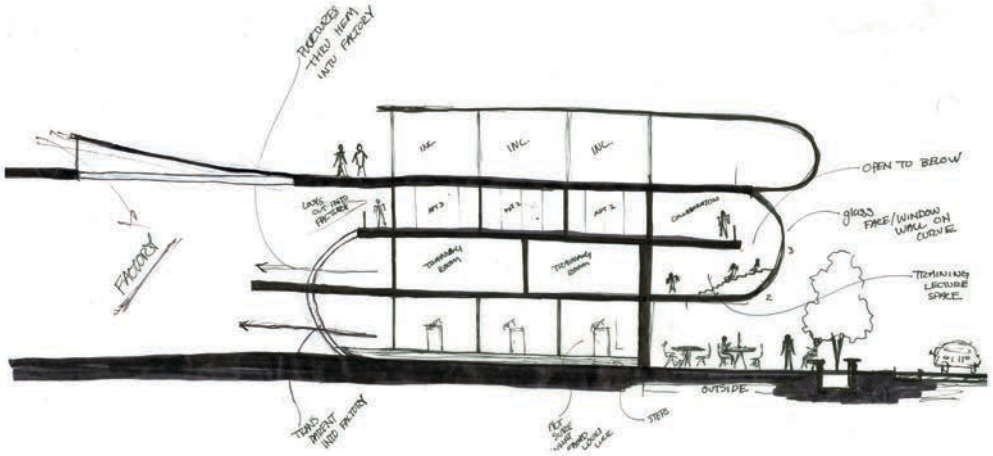

FACTORY
Apt
Apt
Apt
INC
TESTING
INC
Performance/ heavy loading/ unloading

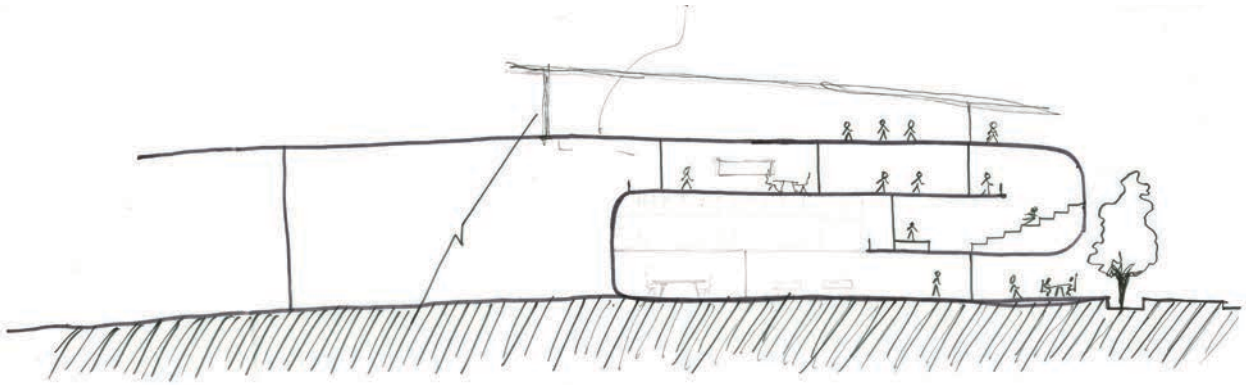

TESTING
INC.

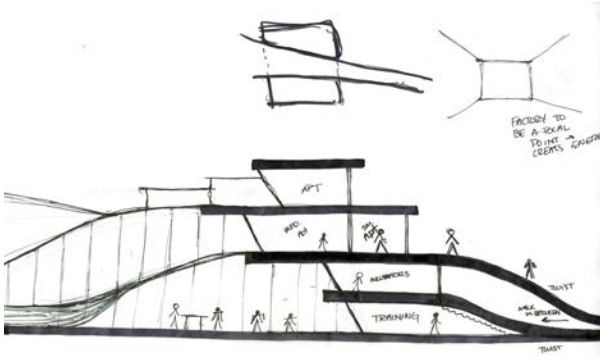

TESTING
(CONNECTION TO FACILITY)
INC.
WELL

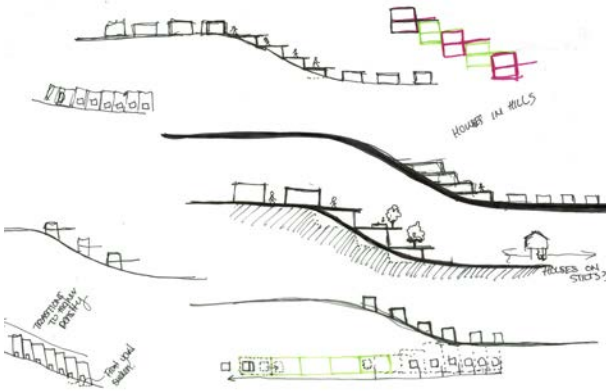

ACTIVE NOISE
TESTING
EXPOSED

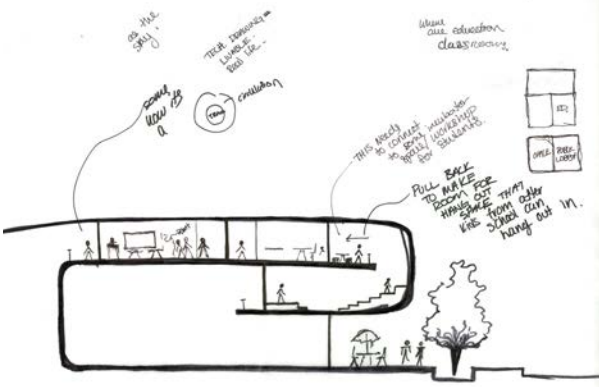

SMALL
20-35ft
MED
30-40 ft
LARGE
40+
GLASS WALL
APT
TESTING
FACTORY
ENTRY
CAN I WALK OUT OF MY APT + BE IN THE FACTORY

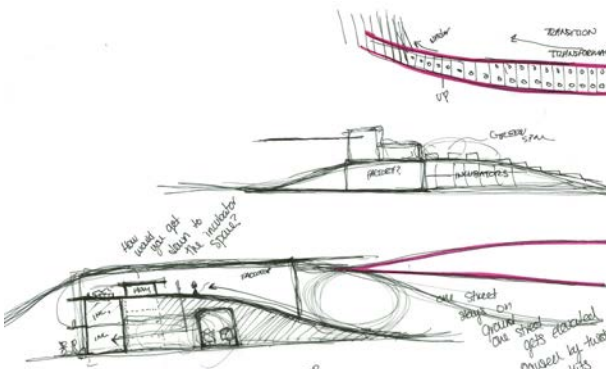

PEDESTRIANS THRU HERE INTO FACTORY
OPEN TO BELOW
glass FACE/WINDOW WALL ON CURVE
FACTORY
OUTSIDE

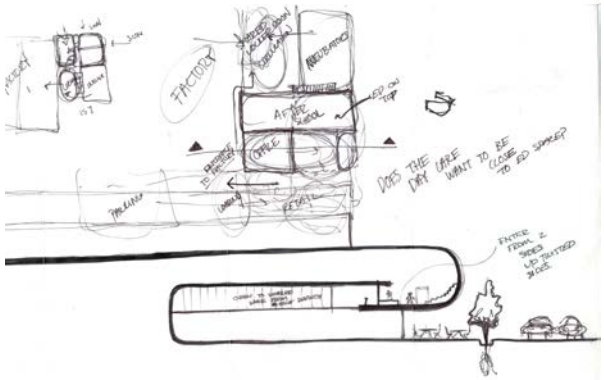


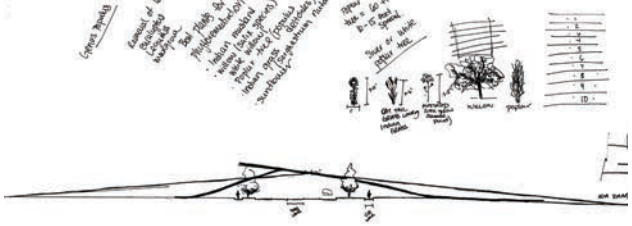

FACTORY TO BE A LOCAL POINT FOR CREATIVE SPACES
APT
TRAINING
TRANSIT

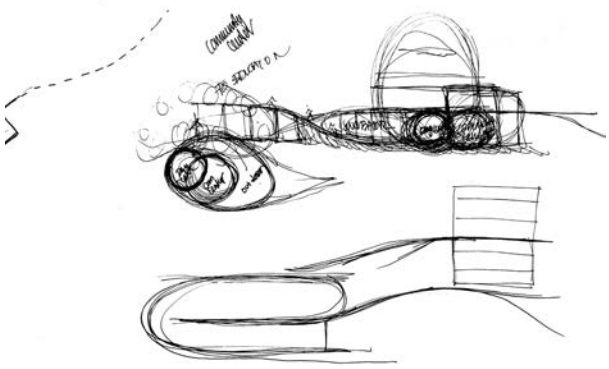

HOUSES IN HILLS
HOUSES ON STILTS?

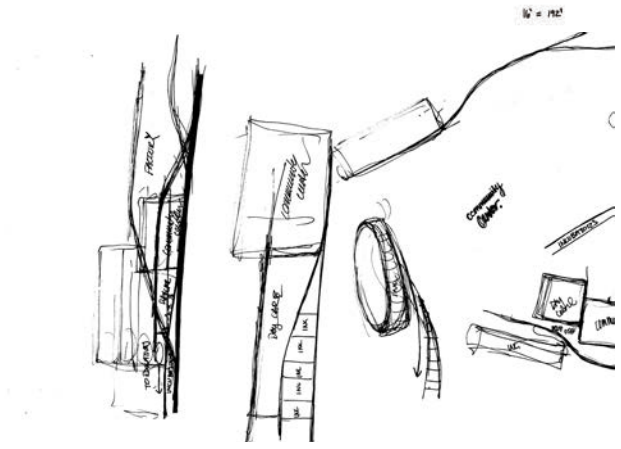

PULL BACK TO MAKE ROOM FOR HANGS OUT SPACE FROM OTHER KIDS SCHOOL CAN HANG OUT IN.

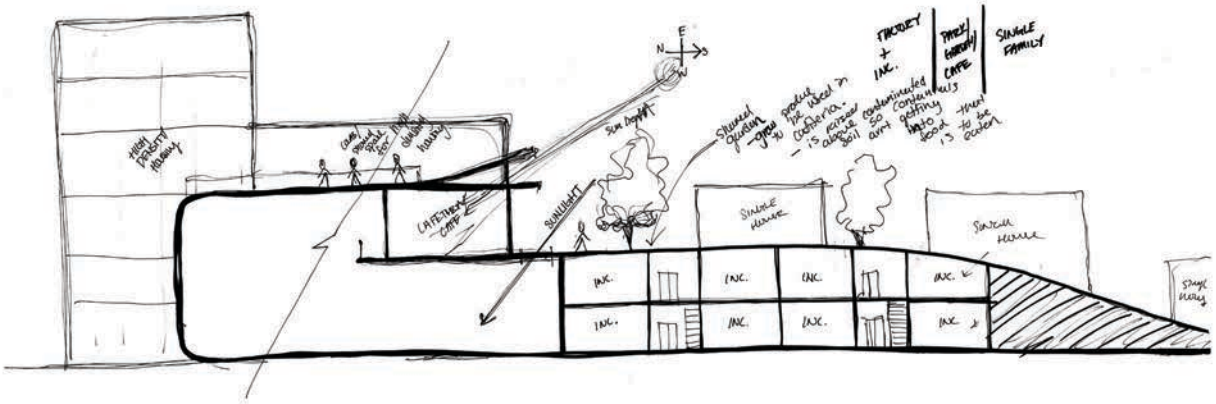

TRANSITION
TRANSFORMATION
FACTORY
How would girls get down to the industrial space?
Old Street
Street on ground
Old Street gets classified
Caused by street when it hits industry.

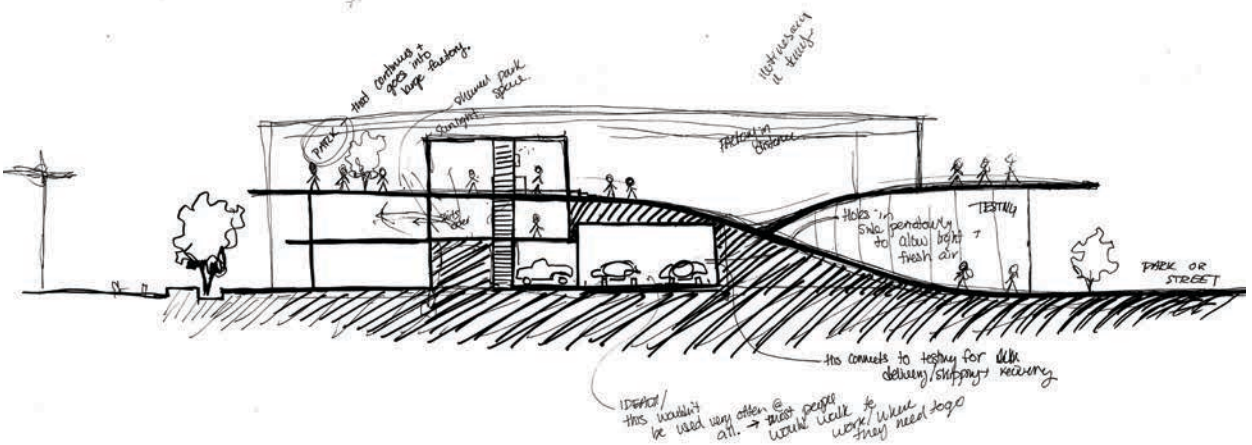

FACTORY
APT
DOES THE DAY CARE WANT TO BE CLOSE TO ED SCHOOL?

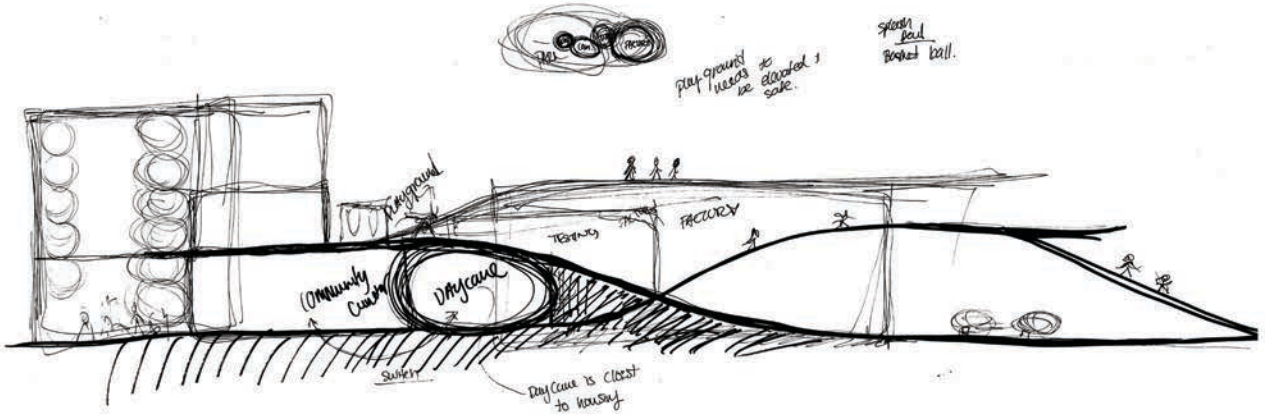


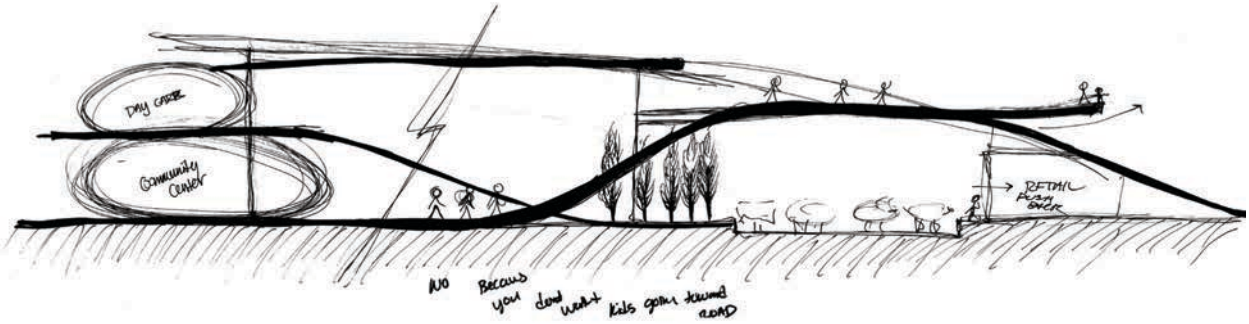

Community Center

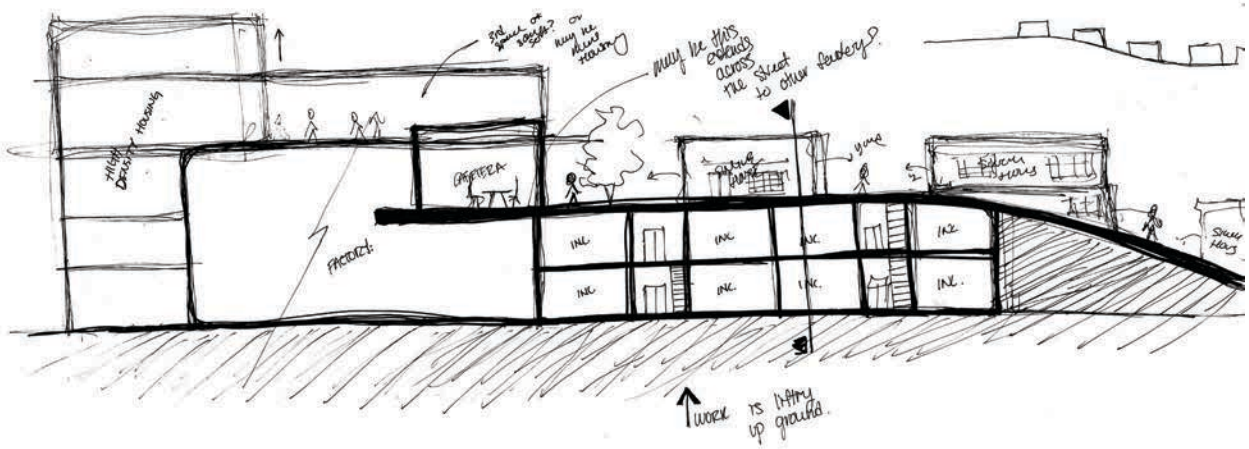

FACTORY
Community Center
DAY CARE

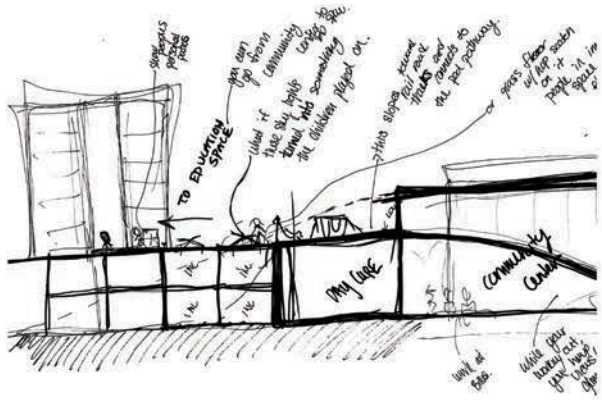

FACTORY + INC.
PARK/ GARDEN/ CAFE
SINGLE FAMILY
N
E
S
W
SUNLIGHT
SUN LIGHT
CAFE/RESTAURANT CAFE
SINGLE HOUSE
INC.
INC.
INC.
INC.
INC.
INC.
INC.
INC.

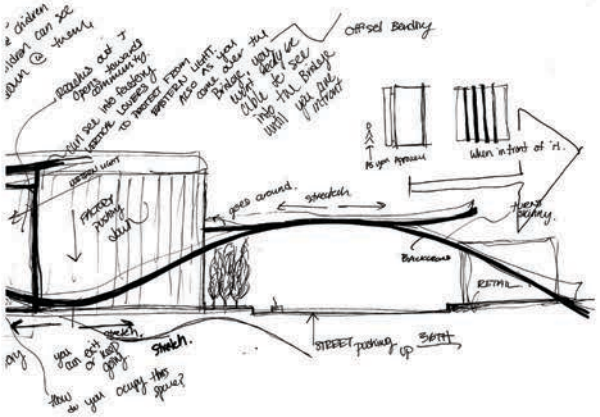

PARK
SUNLIGHT
FACTORY
TESTING
PARK OR STREET

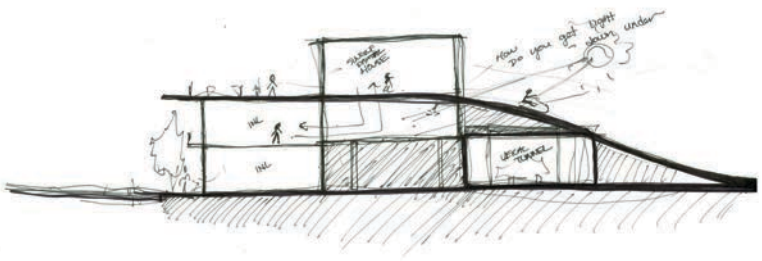

FACTORY
TESTING
DAYCARE
SUNLIGHT

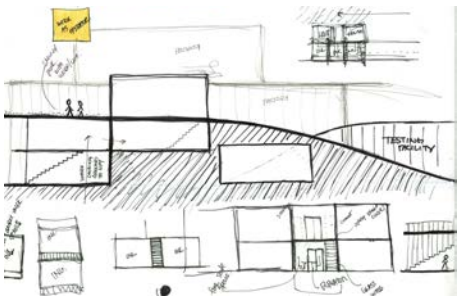

DAY CARE
Community Center
RETAIL
NO Because you dont want kids going toward road


FACTORY
GAZEBO
Existing Trees
INC.
work is happy up grounds.


TO EDUCATION SPACE
DAY CARE
Community Center


Offset Building
stretch
RETAIL
STREET parking
SIDEWALK


How do you get light down under


TESTING FACILITY

IMAGES

Image18:PhotographofmenworkingattheGeneralMotorsStampingPlantcia.1940's.DigitalImage. WyomingHistoricalSociety,2017.

Image19:PhotographofmenworkingattheGeneralMotorsStampingPlantcia.1940's.DigitalImage. WyomingHistoricalSociety,2017.

Image20:Machineslittingsheetmetal.DigitalImage.Formtekgroup. http://formtekgroup.com/product/roll-forming-education/roll-forming-line-arrangement

Image21:Cuttingmetaloperations.CourtneyWierzbicki,2017.

Image22:Machinestretchformingmetal.DigitalImage.Kubesteel. http://www.kubesteel.com/article/20060103-stretch-forming-aluminum-extrusions

Image23:Pressingandformingmetaloperations.CourtneyWierzbicki,2017.

Image24:Metalhemmingmachine.DigitalImage.MRSMetalRollformingSystems. http://mrsrollform.com/hemming-rollformer

Image25:Joiningmetaloperations.CourtneyWierzbicki,2017.

Image26:CurrentconditionofformerGeneralMotorsStampingPlant.Photograph.CourtneyWierzbicki, 2017.

Image27:PCB-electricalequipmentlocatedinexistingsubstations.CRACurrentConditionsReportGrand RapidsMetalStampingPlant.

Image28:PCBImpactedsoiltargetedforremediationOctober22,2015.GHDServicesInc."SoilContaining PCBCleanupCompletionSummaryReport."2015.

Image29:HazardouswastestoragelocationinformerGMStampingPlant.CRACurrentConditionsReport GrandRapidsMetalStampingPlant.

Image30:Sampleofasoilborereport.GHDServicesInc."SoilContainingPCBClean-upCompletion SummaryReport."2015.

Image31:GroundwatercontoursApril2016.GHDSpring2016SemiAnnualGroundwaterMonitoring Report.

Image32:GroundwaterTCEconcentrationcontoursApril2016.GHDSpring2016SemiannualGroundwater MonitoringReport.

Image33:Consolidatedareasofinterest.DigitalMultimedia.AuthorCreated.

Image34:AdvancedmanufacturingIsmoreintellectuallyengagingthenpreviousmanufacturing techniques.Digitalimage.AdvancedManufacturingandSocietyofManufacturingEngineers. http://advancedmanufacturing.org/engineering-successful-career-path/

Image35:UniversityofDetroitMercyCollegeofEngineering&SciencesengagingintheSocietyof ManufacturingEngineers.DigitalImage.SMEFacebookpage. https://www.facebook.com/SMEmfg/photos /rpp.77897771507/10154398268496508/?type=3&theater

Image36:GodwinHeightsSingleFamilyHome.DigitalImage.ReMaxofMichigan. http://www.remax-michigan.com/Home/28-34th-Street-SW-Wyoming-MI-49548/XWT/17004037?&s=AI&aimc=WestMI&aipsid=Godwin-Heights-Public-Schools-Kent-County-MI&aipn=Godwin+Heights+Public+Schools&LD=.

Image37:Howard,Ebenezer.GardenCityDiagram.Digitalimage.GardenCitiesofTomorrow.1902.

Image38:"TheBuellHypothesis."Digitalimage.BuellCenter.http://buellcenter.org/research-programs /buell-hypothesis/buell-hypothesis.

Image39:Foreclosed:RehousingtheAmericanDreamMOMAExhibit.Digitalimage.MoMA. https://www.moma.org/calendar/exhibitions/1213.

Image40:TheGardenintheMachineConceptDiagram.Digitalimage.StudioGang. http://studiogang.com /project/garden-in-the-machine.

Image41:TheGardenintheMachineRendering.Digitalimage.StudioGang. http://studiogang.com/project /garden-in-the-machine.

Image42:NotrespassingsignattheformerGeneralMotorsStampingPlant.Photograph.Courtney Wierzbicki,2017.

Image43:AerialphotographofGeneralMotorsStampingPlant1930/40's.DigitalPhotograph.Wyoming HistoricalSociety.

Image44:Wyomingneighborhoodboundaries,DigitalMedia.CourtneyWierzbicki,2017.

Image45:GodwinHeightscontinuousfabricdiagram,DigitalMedia.CourtneyWierzbicki,2017.

Image46:GodwinHeightsnaturaloperatorsdiagram,DigitalMedia.CourtneyWierzbicki,2017.

Image47:GodwinHeightsinfrastructureoperatorsdiagram,DigitalMedia.CourtneyWierzbicki,2017.

Image48:GodwinHeightsindustrialoperatorsdiagram,DigitalMedia.CourtneyWierzbicki,2017.

Image49:GodwinHeightsalloperatorsdiagram,DigitalMedia.CourtneyWierzbicki,2017.

Image50:GodwinHeightsresultingneighborhoodfabricdiagram,DigitalMedia.CourtneyWierzbicki,2017.

Image51:GodwinHeightscommunitycenterdiagram,DigitalMedia.CourtneyWierzbicki,2017.

Image52:GodwinHeightsfoodandgrocerydiagram,DigitalMedia.CourtneyWierzbicki,2017.Digital Media.CourtneyWierzbicki,2017.

Image53:GodwinHeightstransitdiagram,DigitalMedia.CourtneyWierzbicki,2017.

Image54:GodwinHeightsopenspacediagram,DigitalMedia.CourtneyWierzbicki,2017.

Image55:GodwinHeightsschoolsdiagram,DigitalMedia.CourtneyWierzbicki,2017.

Image56:Neighborhoodneedsstudy,MixedMedia,CourtneyWierzbicki,2017.

Image57:Metalstampingmachine,DigitalImage.OGSIndustries. https://plus.google.com/+Ogsindustries

Image58:Personasandthreescalesofhousingdiagram,DigitalMedia.CourtneyWierzbicki,2017.

Image59:Threescalesofindustrydiagram,DigitalMedia.CourtneyWierzbicki,2017.

Image60:Programdocuments,ExcelDocument.CourtneyWierzbicki,2017.

Image61:Programelementsrelativetospaceallocationdiagram

Image62:Programoperationdiagrams,DigitalMedia.CourtneyWierzbicki,2017.

Image63:Remediationdiagram,Drawing.CourtneyWierzbicki,2017.

Image64:Connectiondiagram,Drawing.CourtneyWierzbicki,2017.

Image65:Neighborhoodneedsdiagram,Drawing.CourtneyWierzbicki,2017.

Image86:Thesisexhibitionboard4,SiteDiagram,DigitalMedia.CourtneyWierzbicki,2017.

Image87:Thesisexhibitionboard5,SitePlan,DigitalMedia.CourtneyWierzbicki,2017.

Image88:Thesisexhibitionboard6,Hemming,DigitalMedia.CourtneyWierzbicki,2017.

Image89:Thesisexhibitionboard7,Stretching,DigitalMedia.CourtneyWierzbicki,2017.

Image90:PegatronCorporationoutdoorspace,DigitalImage.Technobuffalo,2016.

Image91:PegatronCorporationemployeelivingspace,DigitalImage.Technobuffalo,2016.

Image92:EmployeesatPegatronawaittostarttheirshift,DigitalImage.Technobuffalo,2016.

Image93:ArtworkdepictingKPDpanelsinLatinAmerica,DigitalImage.AuthorUnknown.

Image94:ConstructionusingKPDpanels,DigitalImage.ArchDaily.http://www.archdaily.com/516268/chile-s-monolith-controversies-winner-of-the-silver-lion-at-the-venice-biennale

Image95:1972PresidentAllendesignsawetHC1Nwallpanel,DigitalImage.Dezeen. https://www.dezeen.com/2014/06/11/chilean-pavilion-venice-architecture-biennale-2014/.

Image96:KPDpanelatthefactoryentrance,DigitalImage.Dezeen. https://www.dezeen.com/2014/06/11/chilean-pavilion-venice-architecture-biennale-2014/

Image97:Housingandmanufacturingfailuretimeline,DigitalMedia.CourtneyWierzbicki,2017.

Image98:Socioeconomicbreakdown,DigitalMedia.CourtneyWierzbicki,2017.

Image99:Reasonsforfailureinmanufacturingandhousing,DigitalMedia.CourtneyWierzbicki,2017.

Image100:HousingneedinGrandRapidsMetrodiagram,DigitalMedia.CourtneyWierzbicki,2017.

Image101:Needforskilledworkersdiagram,DigitalMedia.CourtneyWierzbicki,2017.

Image102:Transitdiagram,DigitalMedia.CourtneyWierzbicki,2017.

Image103:GodwinHeightsneighborhoodhomes,DigitalImage.GoogleMaps.

Image104:Homesperacreindifferentneighborhoods,DigitalMedia.CourtneyWierzbicki,2017.

BIBLIOGRAPHY

Albanese,Erin."Coffee,Connection,Celebration."SchoolNewsNetwork.

Albanese,Erin."'IWanttoBeCapabletoSpeak.'"SchoolNewsNetwork.

Alonso,Pedro,andHugoSagredo."APanel'sTale:TheSovietI-464SystemandthePoliticsof Assemblage."LatinAmericanModernArchitectures:AmbiguousTerritories,editedbyPatriciodel RealandHelenGyger,NewYork,Routledge,2013,pp.153-69.

Badger,Emily."Wherethe'Americandream'ofhomeownershipisfadingthemost."TheWashingtonPost, February16,2016.

Bazan,Ignacio."TheHistorypanelAllendeTravelingtoVenice."Reportajes,22Mar.2014,pp.11-15.

Berger,BennettM.WorkingClassSuburb.Berkeley:UniversityofCaliforniaPress,1971.

Bilton,Richard."Apple'failingtoprotectChinesefactoryworkers.'"BBCNews,BBCNews,18Dec.2014. Accessed25Oct.2016.

Boljanovic,Vukota.SheetMetalStampingDies.NewYork:IndustrialPressInc.,2013.

Bunn,AustinandChristopherLewis.Rust,WorkingGroupTheatre,8Nov.2012.,https://www.youtube.com /watch?v=rXGQz653Syw.Accessed3Dec.2016.

Cassleman,John.HistoryofJohnCasslemanandGeneralMotorsinWyoming,Michigan.GrandRapids, JohnCassleman,2011.

Chand,Sujeet,andJimDavis."WhatisSmartManufacturing?"TimeMagazine,n.d.

ColumbiaGSAPP."BuellCenter."https://www.arch.columbia.edu/research/centers/2-buell-center.

Davis,Howard.LivingOvertheStore:ArchitectureandLocalUrbanLife.NewYork:Routledge,2012.

DepartmentofEnvironmentalQuality."Part201GenericCleanupCriteriaandScreeningLevels."

DepartmentofEnvironmentalQuality."WhatYouNeedtoKnowifYouOwnorPurchasePropertywith EnvironmentalContamination."2016.

Engels,Friedrich.PrinciplesOfCommunism(Engel'sOriginalDraftoftheCommunistManifesto).Chicago: WorkersPartyofAmericabytheDailyWorkerPub.Co.,1925.

GeraldR.FordInternationalAirport."HistoryandStatistics." http://www.grr.org/history.php.

GHDServicesInc."SoilContainingPCBCleanupCompletionSummaryReport."2015.

Hanlon,Bernadette,ThomasVivino,andJohnRennieShort."TheNewMetropolitanRealityintheUS: RethinkingtheTraditionalModel."UrbanStudies43,no.12(November2006):2129-43.

"HansonTechnologyCenter."LakeMichiganCollege,LakeMichiganCollege.Accessed6Dec.2016.

Harris,Richard."Working-ClassHomeOwnershipintheAmericanMetropolis."JournalofUrbanHistory17, no.1(November1990):46-69.

Hatuka,Tali,andAlexanderD'Hooghe."AfterPostmodernism:ReaddressingtheRoleofUtopiainUrban DesignandPlanning."Places19,no.2(2007):20-27.

Kruse,KevinM.,andThomasI.Sugrue,eds.TheNewSuburbanHistory.2006.

Lewis,Robert.ManufacturingSuburbs.Philadelphia:TempleUniversityPress,2008.AccessedMarch2, 2017.ProQuestEbookCentral.

Liebman,CharlesS."FunctionalDifferentiationandPoliticalCharacteristicsofSuburbs."AmericanJournal ofSociology66,no.5(March1961):485-90."ManufacturinginWestMichigan."TheRightPlace: IndustryReport(2016).

Martin,Reinhold,LeahMeisterlin,andAnnaKenoff.TheBuellHypothesis:RehousingtheAmericanDream. NewYork:ColumbiaUniversity,2011.

MiBiz."HelpWanted:WestMichiganemployersgrapplewithshrinkinglaborpool,skillsgap." https://mibiz.com/item/22409-help-wanted-west-michigan-employers-grapple-with-shrinking-labor-pool-skills-gap.

MuseumofModernArt."Foreclosed:RehousingtheAmericanDream."https://www.moma.org/interactives /exhibitions/2012/foreclosed/.

Oster,Shai."InsideOneoftheWorld'sMostSecretiveIphoneFactories."Bloomberg,24Apr.2016. Accessed25Oct.2016.

Paquin,J.R.,andR.E.Crowley.DieDesignFundamentals.NewYork:IndustrialPressInc.,1987.

Peck,Don."CantheMiddleClassBeSaved?"TheAtlantic(July24,2011).GeneralOneFile.

"RegionalConsolidatedHousingandCommunityDevelopmentPlan."CityofWyoming,CityofGrandRapids. Accessed6Dec.2016.Riis,Jacob.HowtheOtherHalfLives.NewYork:DoverPublications,1971.

Roelofs,Ted."CensusshowsHispanicsfuelmuchofthegrowthinWyomingandotherWestMichigancities." TheGrandRapidsPress,March27,2011.

Sparshott,Jeffery."SkilledWorkersAreScarceinTightLaborMarket."WallStreetJournal,February2,2017.

Strasser,Federico.PracticalDesignofSheetMetalStampings.NewYork:ChiltonCompanyBookDivision, 1959.

Theis,HenryE.HandbookofMetalformingProcesses.NewYork:MarcekDekkerInc.,1999.

ToxicologicalandEnvironmentalAssociates,Inc.FeasibilityEvaluationofAlternativeGreenRemediation Applications.2009.

United States Environmental Protection Agency. "Anatomy of Brownfields Redevelopment."

UnitedStatesEnvironmentalProtectionAgency."AssessingandManagingChemicalsunderTSCA: Trichloroethylene." https://www.epa.gov/assessing-and-managing-chemicals-under-tsca /risk-management-trichloroethylene-tce.

United States Environmental Protection Agency. "Brownfield Overview and Definition." https://www.epa.gov /brownfields/overview-brownfields-program.

VanderEide,Matthew(SeniorProjectGeologistatSME).InterviewwithCourtneyWierzbicki.Personal Interview.GrandRapids,February15,2017.

Vaughn,Charles,andDorothySimon.TheCityofWyoming:AHistory.Wyoming,MI:TheWyomingHistorical CommissionInc,1997.

Voegeli,HenryE.PrinciplesandMethodsofSheet-MetalFabricating.NewYork:ReinholdPublishing Corporation,1966.