Online Appendix

Peer effects in voluntary environmental policies: An application to urban water quality

Daniel A. Brent[1], Douglas H. Wrenn[1], Gabriel R. Lara[1] and Joseph Cook[2]

[1]Pennsylvania State University

[2]Washington State University

July 2025

Contents

List of Figures

List of Tables

A Additional Figures

Figure A.1: Examples of Google Street View Imagery

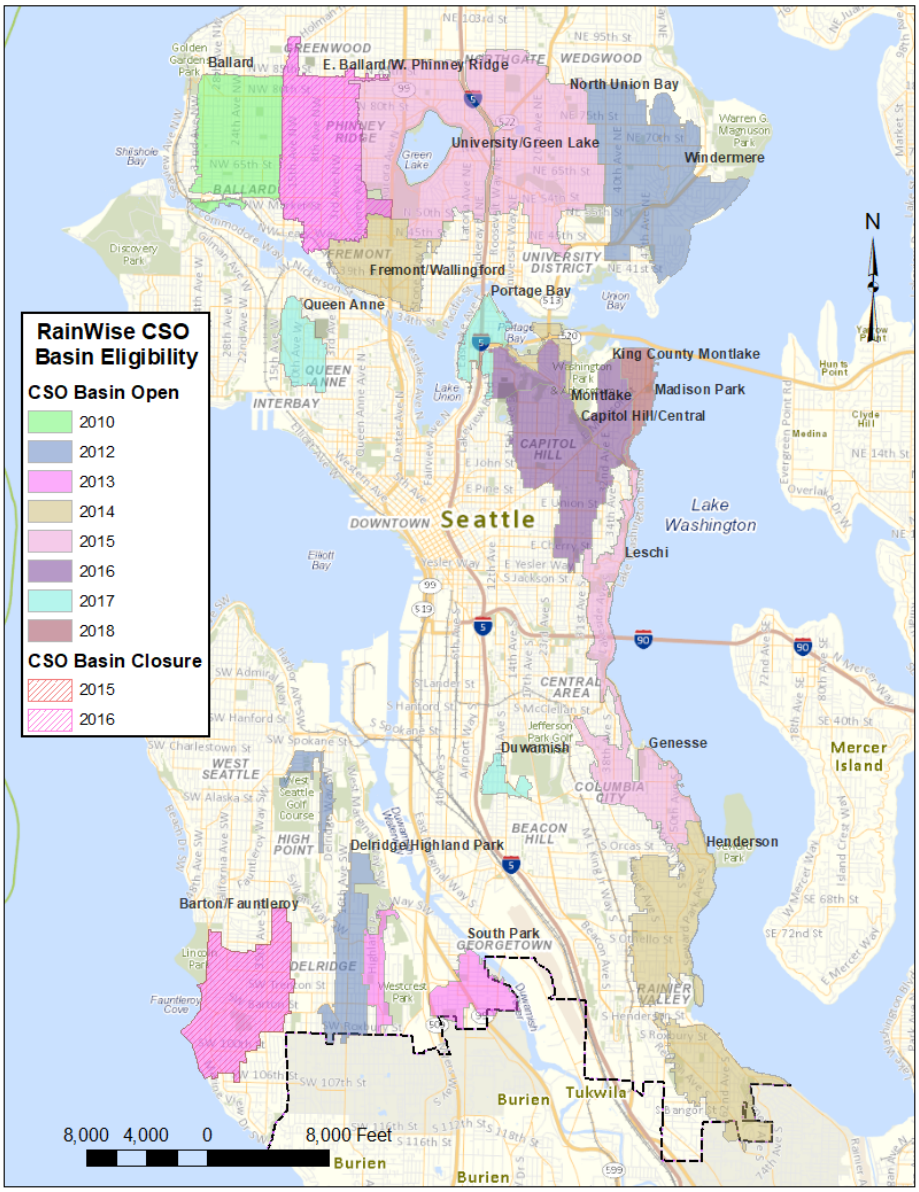
(a) Street View with Sign

(b) Street View with Visible Rain Garden

(c) Street View with Visible Cistern

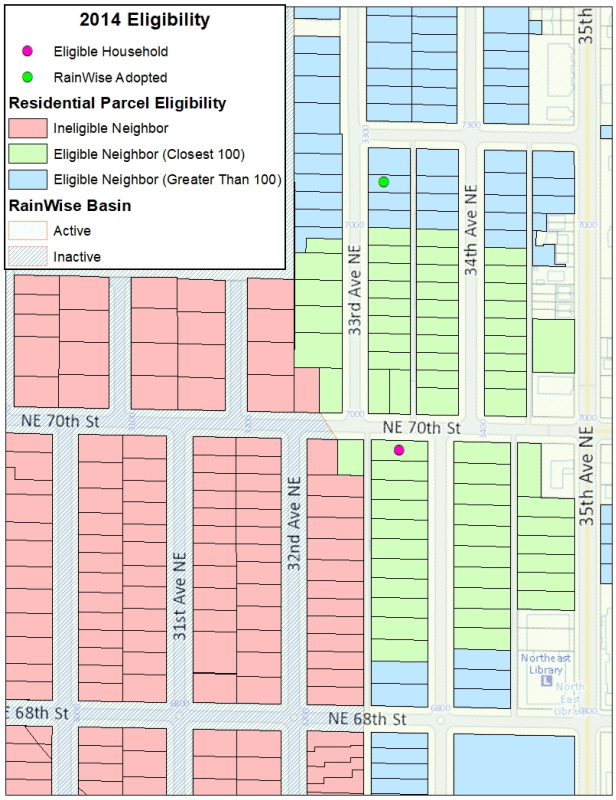
Notes: The images are from RainWise adoptions using the publicly available Google Street View.

Figure A.2: RainWise CSO Basin Eligibility



Note: The map shows the Combined Sewer Outflow basin's that are eligible for RainWise along with the dates when eligibility began. The basins with diagonal lines closed eligibility at the specified dates.

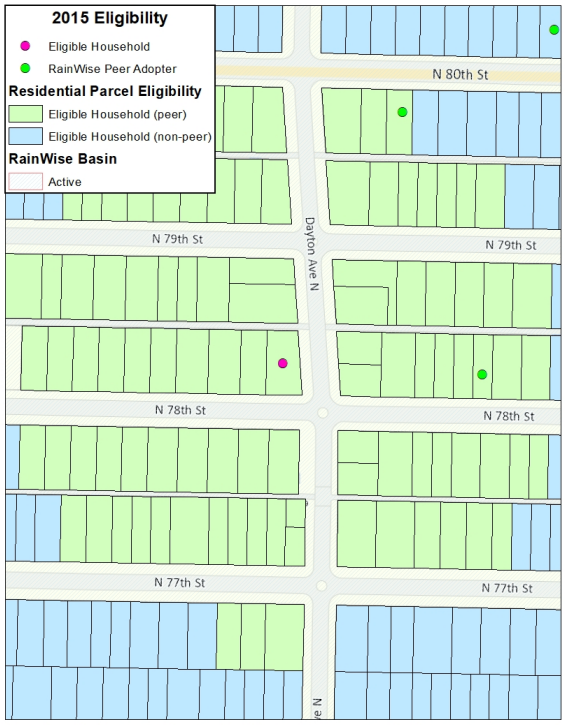
Figure A.3: Peer Groups

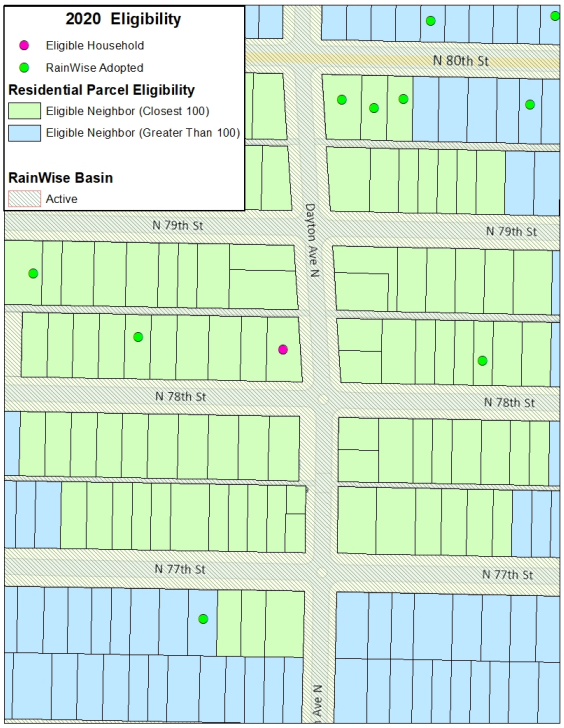


Note: The red dot represents the household of interest. The red and green parcels represent the peer group of the 100 nearest households within 0.5 miles. Eligible parcels are colored in green and ineligible parcels are red. Blue parcels are households outside of the peer group. The green dots represent households that signed up for RainWise.

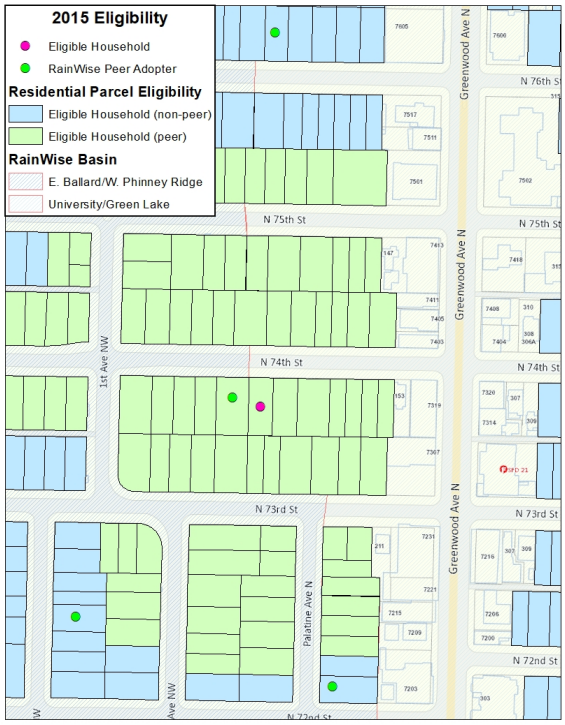
Figure A.4: Temporal Variation in the Number of Eligible Peers

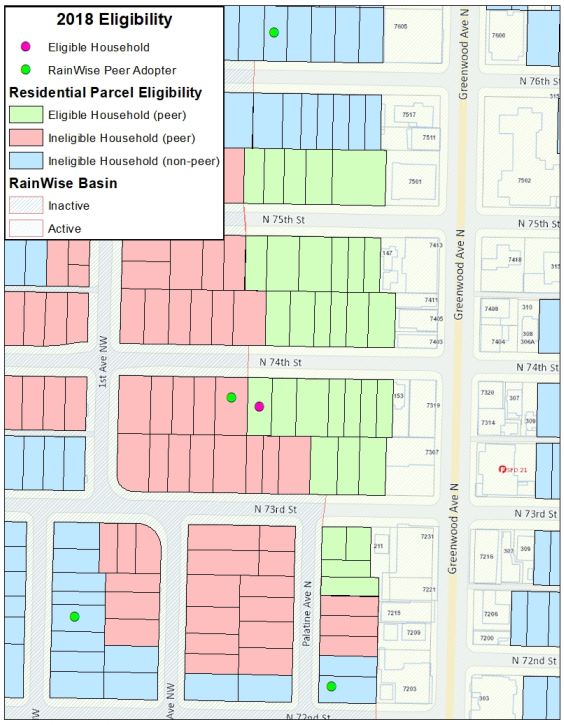
Household 1: 2015 **Household 1: 2018**





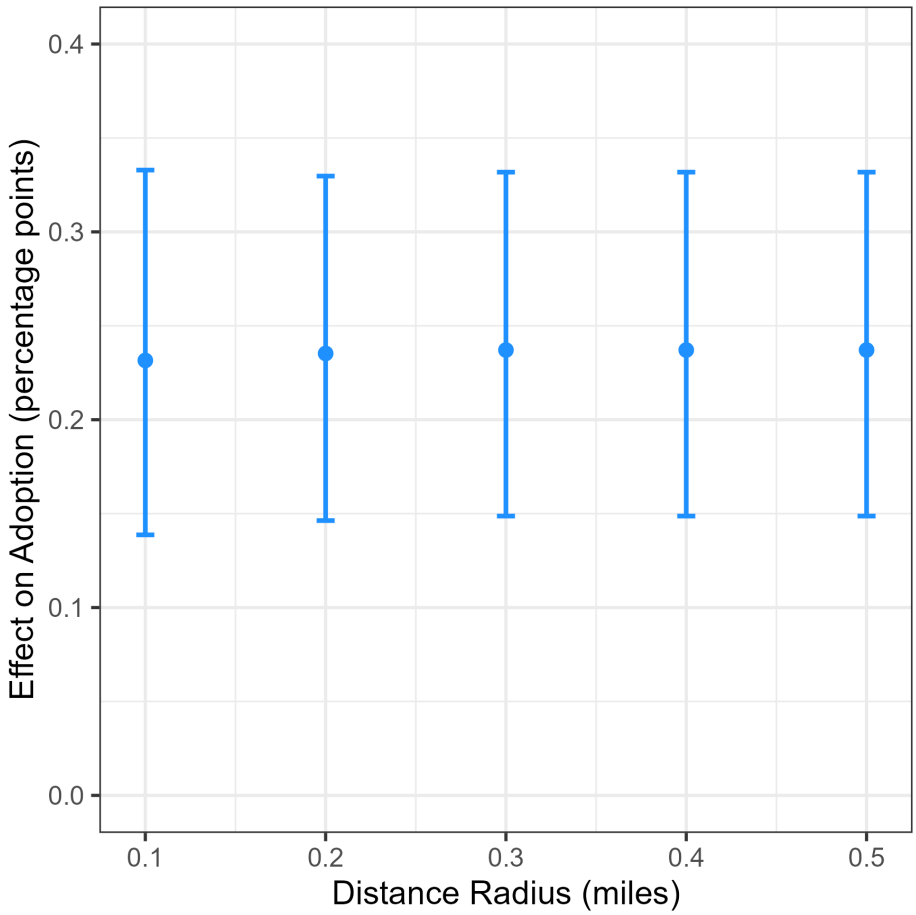
Household 3: 2015 **Household 3: 2018**





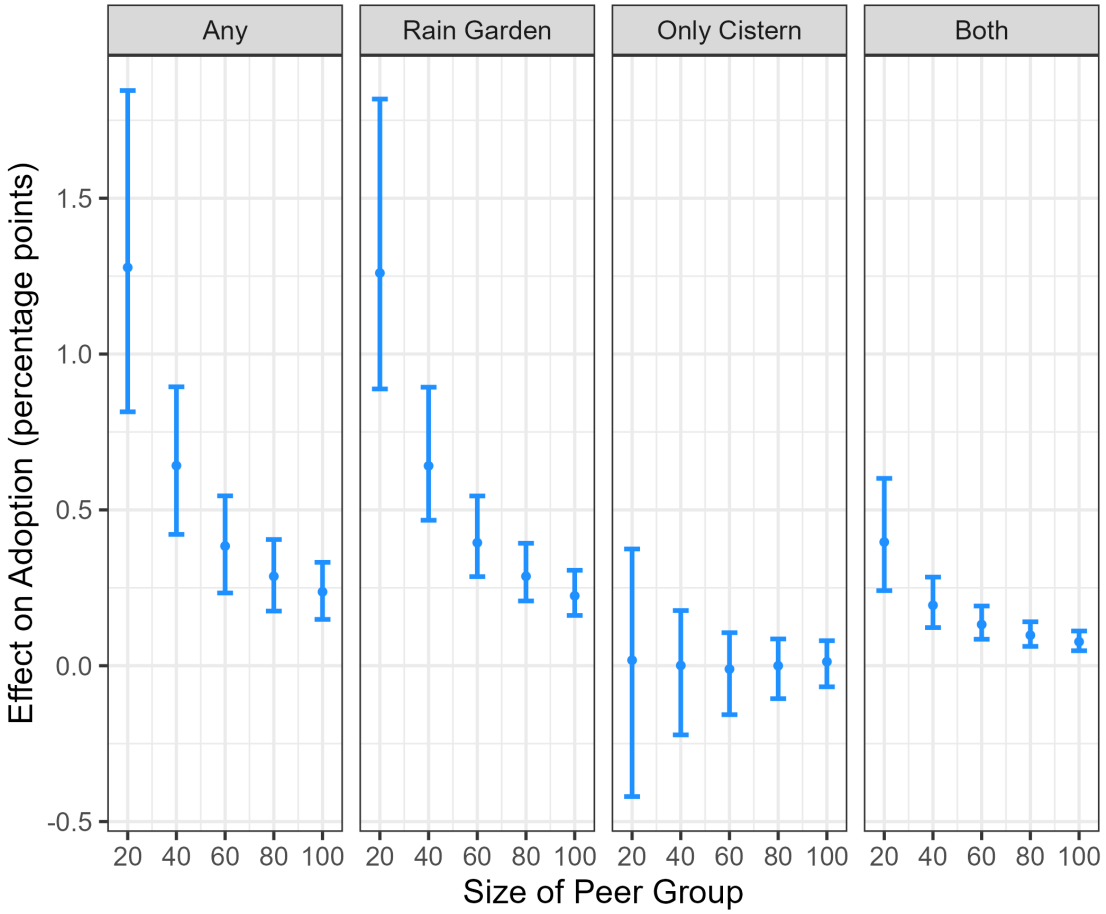
Note: The red dot represents the household of interest. The red and green parcels represent the peer group of the 100 nearest households within 0.5 miles. Eligible parcels are colored in green and ineligible parcels are red. Blue parcels are households outside of the peer group. The green dots represent households that signed up for RainWise. The different years show the same household at different points in time.

Figure A.5: Peer effects across spatial definition of peer group



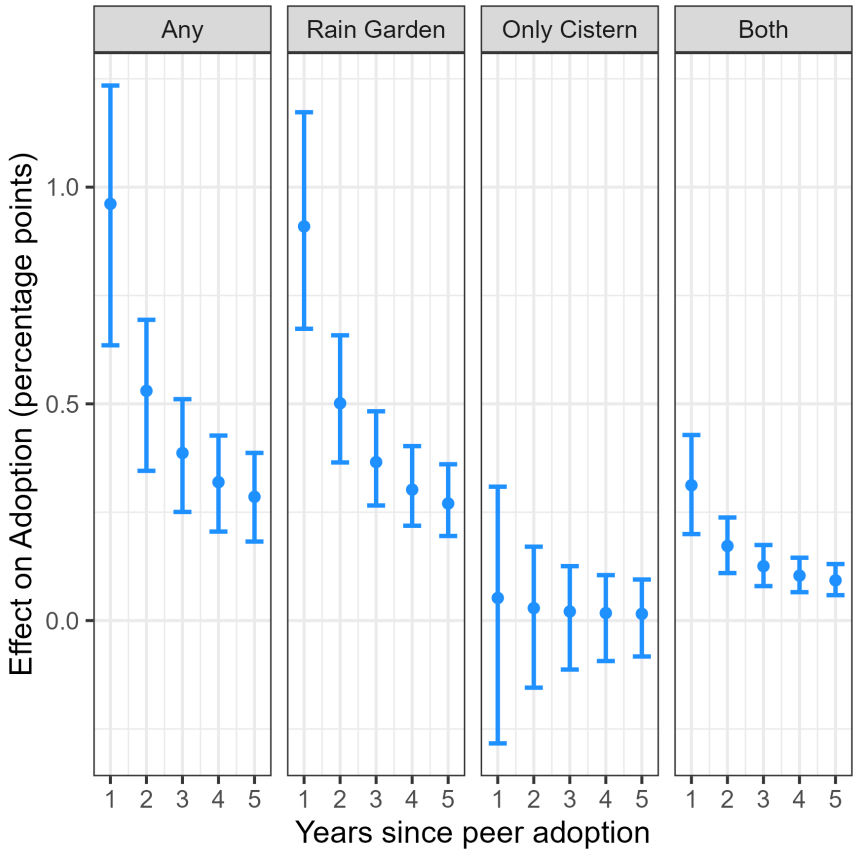
Notes: The dependent variable is an indicator for whether a household signed up for RainWise in a given year. The dots represent point estimates for different distance thresholds. The 0.5 mile estimate replicates column (3) of Table **??**. Peer adoption is instrumented with the average of cistern-eligible and rain garden-eligible peers. The regressions control for block group and year fixed effects and the total number of peers (eligible and ineligible). The error bars are 95% Anderson-Rubin confidence intervals based on inverting the AR test statistic.

Figure A.6: Heterogeneous peer effects varying the number of households in peer group by technology and peer technology



Notes: The dependent variables are an indicator for whether a household signed up for specific RainWise technology in a given year. Each panel represents a different dependent variable as indicated by the panel header. Rain Garden refers to either only rain garden or rain garden and cistern. The dots represent point estimates for different number of peers in the peer group run in separate regressions. Peer adoption is instrumented with the average of cistern-eligible and rain garden-eligible peers. The regressions control for block group and year fixed effects and the total number of peers (eligible and ineligible). The error bars are 95% Anderson-Rubin confidence intervals based on inverting the AR test statistic.

Figure A.7: Heterogeneous peer effects varying the timing of adoption in peer group by technology and peer technology



Notes: The dependent variables are an indicator for whether a household signed up for specific RainWise technology in a given year. Each panel represents a different dependent variable as indicated by the panel header. Rain Garden refers to either only rain garden or rain garden and cistern. The dependent variable is an indicator for whether a household signed up for RainWise in a given year. The x-axis represents the years since peer adoption, so 5 is the number of peer adoptions in the five previous years. The dots represent point estimates for different timing on peer adoption, each representing a separate regression. Peer adoption is instrumented with the average of cistern-eligible and rain garden-eligible peers. The regressions control for block group and year fixed effects and the total number of peers (eligible and ineligible). The error bars are 95% Anderson-Rubin confidence intervals based on inverting the AR test statistic.

B Additional Tables

Table A.1: Correlation of explanatory variables with adoption

	Property		Census		Both	
	(1)	(2)	(3)	(4)	(5)	(6)
Sq. Ft.	-0.0007	-0.0008			-0.0006	-0.0008
	(0.0011)	(0.0024)			(0.0009)	(0.0021)
Lot	0.0018*	0.0071*			0.0020**	0.0078*
	(0.0010)	(0.0040)			(0.0010)	(0.0042)
Bedrooms	0.0017*	0.0025*			0.0016	0.0022
	(0.0009)	(0.0014)			(0.0011)	(0.0017)
Bathrooms	0.0003	-0.0011			-0.0001	-0.0016
	(0.0010)	(0.0017)			(0.0009)	(0.0017)
Year Built	-0.0094***	-0.0113***			-0.0103***	-0.0126***
	(0.0010)	(0.0016)			(0.0017)	(0.0025)
Assessed Value	-0.0004	0.0004			-0.0005	0.0006
	(0.0008)	(0.0035)			(0.0008)	(0.0040)
Median Income			-0.0017	-0.0002	-0.0010	0.0003
			(0.0023)	(0.0040)	(0.0021)	(0.0036)
Non-white			-0.0032	-0.0068	-0.0023	-0.0048
			(0.0034)	(0.0049)	(0.0031)	(0.0042)
Active Trans.			0.0017	0.0011	0.0014	0.0010
			(0.0013)	(0.0025)	(0.0013)	(0.0022)
Degree			-0.0058	-0.0053	-0.0051	-0.0037
			(0.0036)	(0.0050)	(0.0033)	(0.0046)
Owner Occupied			0.0033	0.0024	0.0007	-0.0018
			(0.0021)	(0.0033)	(0.0018)	(0.0028)
Gov. Assistance			0.0001	-0.0003	0.0005	0.0004
			(0.0019)	(0.0025)	(0.0019)	(0.0025)
Fixed-effects						
Block Group	Yes	Yes				
Tract			Yes	Yes	Yes	Yes
# Block Group	238	222	–	–	–	–
# Tract	–	–	80	78	80	78
Observations	65,402	37,750	65,402	37,750	65,402	37,750
Sample	Cistern Only	Cistern & Rain Garden	Cistern Only	Cistern & Rain Garden	Cistern Only	Cistern & Rain Garden

Note: The dependent variable is a dummy equal to one if the household adopted RainWise at any point in the sample. The sample is designated as either eligible for cisterns or both cisterns and rain gardens. In both cases any peer or household eligible for a rain garden is also eligible for cisterns. Lot is in the lot size in 1000 square feet and Assessed Value is in 1000 dollars. All census variables are standardized and measured at the block group level. All standard errors are clustered at the block group level. *p<0.1; **p<0.05; ***p<0.01

Table A.2: Google Street View Summary Statistics

	Mean	SD	N
Visibility			
Any	0.589	0.492	1915
Rain Garden	0.684	0.465	687
Cistern	0.410	0.492	946
Both	0.780	0.415	282
Sign			
Any	0.326	0.469	1915
Rain Garden	0.329	0.470	687
Cistern	0.309	0.462	946
Both	0.376	0.485	282
Duration (Years)	1.244	1.872	623
Years Between Images	1.870	1.042	258

Notes: Visibility is the average proportion of a technology's visibility. Sign is the average proportion of households displaying a sign based on the technology adopted. After adopting, households displayed a sign for an average of 1.2 years, and 1.87 years elapsed between street view images.

Table A.3: Peer effects heterogeneity by visibility proxies

	(1)	(2)	(3)	(4)	(5)
Peer $\widehat{\text{Adoptions}}$	0.237***	0.123	0.229***	0.126	0.157
	(0.045)	(0.099)	(0.050)	(0.095)	(0.105)
Peer $\widehat{\text{Adoptions}}$ Corner		1.04		1.08	
		(0.713)		(0.793)	
Peer $\widehat{\text{Adoptions}}$ Bus			0.210	-0.084	
			(0.377)	(0.544)	
Peer $\widehat{\text{Adoptions}}$*High Active					0.255***
					(0.097)
Peer $\widehat{\text{Adoptions}}$*High Income					-0.097
					(0.089)
Peer $\widehat{\text{Adoptions}}$*High Own					0.055
					(0.100)
Fixed-effects					
Block Group (238)	Yes	Yes	Yes	Yes	Yes
Year (10)	Yes	Yes	Yes	Yes	Yes
Observations	416,477	416,477	416,477	416,477	416,477

Notes: The dependent variable is an indicator for whether a household signed up for RainWise GSI in a given year. Columns (1) replicates the base effect from Table **??**. Column (2) includes an interaction of peer adoptions that take place on corner lots as well as the number of total peers on corner lots. Column (3) includes an interaction of peer adoptions that are within the 10 closest houses to a bus stop as well as the total number of peers near bus stops. Column (4) incorporates both corner and bus stop interactions. Column (5) interacts peer adoptions with indicators for parcels in census blocks above the median for active transportation (Active), median income (Income), and home ownership (Own). Active transportation is defined as the percentage of commuters who walk, bike, or take public transit. The instruments in column (5) are also interacted with the three census indicators. The regressions control for block group and year fixed effects and the total number of peers (eligible and ineligible). Standard errors are clustered at the block group level. *p<0.1; **p<0.05; ***p<0.01

Table A.4: Peer effects - rain garden eligible

	(1) OLS	(2) First Stage	(3) IV	(4)
Peer Adoptions	-0.016			
	(0.017)			
# Eligible Peers (CS)		0.008		
		(0.006)		
# Eligible Peers (RG)		0.016***		
		(0.003)		
Peer $\widehat{\text{Adoptions}}$			0.205***	0.205***
			(0.068)	(0.073)
Fixed-effects				
Year (10)	Yes	Yes	Yes	Yes
Block Group (222)	Yes	Yes	Yes	Yes
Observations	248,733	248,733	248,733	248,733
F			18.52	30.13
AR CI			[0.03, 0.36]	[0.06, 0.36]
tF cF				2.35
tF CI				[0.03, 0.38]

Notes: The dependent variable is an indicator for whether a household signed up for RainWise in a given year. The IV specification uses the number of eligible peers as an instrument for the number of peer adopters. Regressions also control block group and year fixed effects and the total number of peers (eligible and ineligible). Standard errors are clustered at the block group level. *p<0.1; **p<0.05; ***p<0.01

Table A.5: Peer effects heterogeneity by type of GSI - rain garden eligible sample eligible

	(1) Any	(2) Rain Garden	(3) Only Cistern	(4) Only Rain Garden	(5) Both
Peer $\widehat{\text{Adoptions}}$	0.205***	0.153***	0.052	0.093*	0.059**
	(0.073)	(0.055)	(0.039)	(0.049)	(0.025)
Fixed-effects					
Year (10)	Yes	Yes	Yes	Yes	Yes
Block Group (222)	Yes	Yes	Yes	Yes	Yes
Observations	248,733	248,733	248,733	248,733	248,733
F	30.1	30.1	30.1	30.1	30.1
AR CI	[0.06, 0.36]	[0.04, 0.27]	[-0.03, 0.14]	[-0.01, 0.2]	[0.04, 0.27]

Notes: The dependent variable is an indicator for whether a household signed up for a specific type of RainWise GSI in a given year. Columns (1) and (2) estimate the effect of any peer adoption on a household's rain garden or cistern adoption separately. Columns (3) and (4) estimate the effect of rain garden and cistern peer adoption on any RainWise adoption. Columns (5) and (6) estimate the effect of peer rain garden (cistern) adoption on household rain garden (cistern) adoption. The IV specification uses the number of eligible peers as an instrument for the number of peer adopters. Regressions also control basin and year fixed effects and the total number of peers (eligible and ineligible). Standard errors are clustered at the block group level. *p<0.1; **p<0.05; ***p<0.01

Table A.6: Relationship between drainage problems and eligible peers

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Elevation	0.023***					0.019***	
	(0.002)					(0.002)	
Elevation:Q2		4.684***					4.399***
		(0.189)					(0.189)
Elevation:Q3		8.060***					7.737***
		(0.190)					(0.189)
Elevation:Q4		5.621***					5.668***
		(0.190)					(0.189)
Elevation:Q5		1.540***					0.926***
		(0.189)					(0.191)
Drainage > 0.5 mile			0.004				
			(0.180)				
Drainage Distance				10.034***			
				(0.571)			
Drainage 0.1-0.2 mile					3.877***	3.829***	3.953***
					(0.162)	(0.162)	(0.159)
Drainage 0.2-0.3 mile					5.212***	5.063***	5.252***
					(0.183)	(0.184)	(0.182)
Drainage 0.3-0.4 mile					2.452***	2.326***	1.964***
					(0.236)	(0.236)	(0.234)
Drainage 0.4-0.5 mile					2.017***	1.975***	2.044***
					(0.299)	(0.299)	(0.294)
Drainage > 0.5 mile					2.629***	2.852***	2.467***
					(0.201)	(0.203)	(0.200)
Constant	88.139***	85.728***	89.702***	87.978***	87.073***	85.788***	83.364***
	(0.145)	(0.134)	(0.168)	(0.119)	(0.113)	(0.172)	(0.162)
Observations	65,354	65,354	65,402	56,790	65,402	65,354	65,354

Notes: The dependent variable is the maximum number of eligible peers at any point in the sample. This abstracts away from the temporal variation in the peer eligibility and focuses on the static component, which is the dominant form of variation. Column (1) includes the property's elevation as a predictor of the number of eligible peers, and column (2) divides this into elevation quintiles with the lowest elevation as the reference category. Column (3) uses a dummy for whether there is a capacity constrained drainage location less than 0.5 miles from the property. Column (4) examines the distance to a capacity constrained drainage location conditional on being less than 0.5 miles away. Column (5) separates the distances into 0.1 mile bins with less than 0.1 miles as the reference category. Columns (6) and (7) incorporate both elevation and capacity constrained drainage locations into the regressions together. *p<0.1; **p<0.05; ***p<0.01

Table A.7: Robustness of peer effects to spatial fixed effects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Peer $\widehat{\text{Adoptions}}$	0.24***	0.24***	0.16***	0.21***	0.17***	0.23***	0.22***
	(0.05)	(0.06)	(0.05)	(0.06)	(0.05)	(0.06)	(0.04)
Fixed effects, controls, and sample							
Block Group (238)	Yes						
Year (10)	Yes	Yes	Yes	Yes	Yes		
Basin (19)		Yes					
Zipcode (22)			Yes				
Sub-Area (70)				Yes			
Tract (80)					Yes		
Basin-Year (116)						Yes	
Block Group-Year (1,573)							Yes
Observations	416,477	416,477	416,477	416,477	416,477	416,477	416,477
F	45.2	8.2	8.2	12.7	16.0	8.2	48.6
AR CI	[0.15, 0.34]	[0.16, 0.55]	[0.16, 0.55]	[0.08, 0.4]	[0.06, 0.3]	[0.16, 0.55]	[0.13, 0.31]

Notes: The dependent variable is an indicator for whether a household signed up for RainWise in a given year. Column (1) replicates the base specification. Column (2)-(5) use different spatial fixed effects in addition to year fixed effects designated in the *Fixed-effects* panel. The parentheses designate the unique number of levels in the fixed effect. Column (6) uses basin-by-year fixed effects and column (7) uses block group-by-year fixed effects. Standard errors are clustered at the level of the fixed effect and use two-way clustering for columns (6) and (7). *p<0.1; **p<0.05; ***p<0.01

C Main Data Creation

C.1 Download Data Files

First, we downloaded all RainWise program data, including GIS layer files, from the Seattle Public Utilities (SPU) through a City of Seattle Public Disclosure Request. We also downloaded a GIS layer containing all tax parcels in King County from the King County GIS Data website on September 5, 2022. This layer also includes place-holder polygons, which do not represent tax parcels but are included to identify platted and unplatted land descriptions. In addition, the layer includes stacked polygon geometry for undivided interest and vertical parcels. King County parcel numbers may include leading zeros in PIN. The raw data files are located in the "folder path". Below is the raw data file name and description. Tables **??** through **??** lays out the data structure of each data file and lists variables used in the sample construction.

1. **Eligible Parcels in RainWise Basins**: SPU determined parcels that are eligible for either a cistern, rain garden, or both within each specified basin, excluding East Ballard and West Phinney, and Barton Fauntleroy basins. The eligible parcels encompass several parcel types, including single-family (residential use/zone), duplexes, or residential condominiums. Each parcel is assigned a unique Parcel Identification Number (PIN). All data records are geocoded and correspond to a unique latitudinal and longitudinal coordinate. All original geocoded data records are presented as polygons.

2. **Eligible Parcels in Barton Fauntleroy Basin**: SPU determined parcels eligible for either a cistern, rain garden, or both within the Barton Fauntleroy basin. The eligible parcels encompass several parcel types, including single-family (residential use/zone), duplexes, or residential condominiums. Each parcel is assigned a unique Parcel Identification Number (PIN). All data records are geocoded and correspond to a unique latitudinal and longitudinal coordinate. All original geocoded data records are presented as polygons.

3. **Eligible Parcels in East Ballard/West Phinney Basins**: SPU determined parcels that are eligible for either a cistern, rain garden, or both within the East Ballard/West Phinney basin. The eligible parcels encompass several parcel types, including single-family (residential use/zone), duplexes, or residential condominiums. Each parcel is assigned a unique Parcel Identification Number (PIN). All data records are geocoded and correspond to a unique latitudinal and longitudinal coordinate. All original geocoded data records are presented as polygons.

4. **RainWise Adoption Parcel Records**: SPU RainWise adoption parcel records that have adopted either a cistern, rain garden, or both with corresponding rebate and data of installation information. The adopted parcels encompass several types: single-family (residential use/zone), duplexes, or residential condominiums. Each parcel is assigned a unique Parcel Identification Number (PIN). All data records are geocoded and correspond to a unique latitudinal and longitudinal coordinate. All original geocoded data records are presented as feature points.

5. **RainWise Combined Sewer Outfall (CSO) Basin Records**: SPU RainWise basin information, including basin opening and closing date. Each basin is presented as a polygon and is geocoded.

6. **King County Parcel Records**: King County parcel records information as of August 29, 2022. The original file was published on November 1, 2006. The file includes characteristic parcel information, including parcel address and type (e.g., single-family (residential use/zone), duplex, residential condominium). In addition, each parcel is assigned a unique Parcel Identification Number (PIN). All data records are geocoded and correspond to a unique latitudinal and longitudinal coordinate. All original geocoded data records are presented as polygons.

Table A.8: Eligible Parcels in RainWise Basins

Field	Field Description
OBJECTID *	Unique shapefile identifier
shape *	Polygon
pin	Unique parcel Identification Number
presentuse	Parcel type code
pres_use_desc	Parcel type description
STR_HOUSE	Parcel street number
STR_MOD	Parcel street modification
STR_PREF	Parcel street prefix
STR_NAME	Parcel street name
STR_TYPE	Parcel street type
STR_SUFF	Parcel street suffix
STR_ZIP	Parcel street address
Cistern to Side Sewer Eligible	Parcel eligible for cistern side sewer equal to 1 or 0
Rain Garden & Cistern Eligible for Rebates	RainWise rebate amount
CisternToSSAreaPercent	Cistern to area percentage
Eligibility	Parcel type eligibility (rain garden or cistern)
shape_Length	Shape length
shape_Area	Shape area

Table A.9: Eligible Parcels in Barton Fauntleroy Basin

Field	Field Description
OBJECTID	Unique shapefile identifier
Shape*	Polygon
PIN	Unique parcel Identification Number
GSI_Feas	Parcel type eligibility (rain garden or cistern)
Shape_Leng	Shape length
Shape_Area	Shape area

Table A.10: Eligible Parcels in East Ballard/West Phinney Basins

Field	Field Description
Shape *	Polygon
OBJECTID	Unique shapefile identifier
PIN	Unique parcel Identification Number
GSI_Feasib	Parcel type eligibility (rain garden or cistern)
Shape_Leng	Shape length
Shape_Area	Shape area

Table A.11: RainWise Adoption Parcel Records

Field	Field Description
OBJECTID *	Unique shapefile identifier
RNWS_FEA_TYPE	Rainwise type (cistern or rain garden)
RNWS_DATA_SOURCE_TEXT	Rainwise datasource (e.g., SPU)
RNWS_PIN_ID	Unique parcel Identification Number
RNWS_CSO_BASIN_NAME	RainWise CSO basin
SHAPE *	Point

Table A.12: RainWise Combined Sewer Outfall (CSO) Basin Records

Field	Field Description
Shape *	Polygon
OBJECTID	Unique shapefile identifier
AREA	Polygon area
CSOB_OUTFA *	CSO basin
OWNER	CSO basin owner
ACTIVE	CSO basin active status
Shape_Leng	Shape length
Shape_Area	Shape area
Open_Year	CSO basin open year
Close_Year	CSO basin close year

Table A.13: King County Parcel Records

Field	Field Description
Shape *	Polygon
OBJECTID	Unique shapefile identifier
PIN	Unique parcel Identification Number
ADDR_HN	Parcel house number
ADDR_SN	Parcel street number
ADDR_ST	Parcel street
ADDR_SD	Parcel street direction
ADDR_NUM	Parcel street address number
ADDR_FULL	Parcel street address
FULLNAME	Parcel street address
ZIP5	Parcel zip code
PLUS4	Parcel zi cope full
CTYNAME	Parcel city name
LAT	Parcel latitude
LON	Parcel longitude
COUNTY	Parcel county
PROPTYPE	Parcel property type
PREUSE_COD	Parcel type code
PREUSE_DES	Parcel type description
Shape_Length	Shape length
Shape_Area	Shape area

C.2 Clean and Prepare Raw Data Files using GIS

All raw data files are loaded into ESRI ArcGIS Desktop 10.8.2 to clean and prepare the data for panel data creation. The following steps are performed in ArcMap. We conducted and implemented quality assurance and control reviews throughout the process to maintain the data's accuracy and consistency.

1. We loaded the following shapefile geodata files:
   (a) Eligible Parcels in RainWise Basins
   (b) Eligible Parcels in Barton Fauntleroy Basin
   (c) Eligible Parcels in East Ballard/West Phinney Basins
   (d) RainWise Adoption Parcel Record
   (e) RainWise Combined Sewer Outfall (CSO) Basin Record
   (f) King County Adoption Parcel Record
2. We projected each loaded spatial data file from their previous coordinate system to the NAD_1983_HARN_StatePlane_Washington_North_FIPS_4601_Feet coordinate system.
3. We converted geodata files (a) through (d) from their original polygon state to a feature point inside the featured polygon.
4. We performed an intersect analysis (i.e., geometric intersection) between geodata files (a) (feature point) and (e). The feature point in geodata file (a) will intersect (overlap) with the basin geocoded polygons in dataset (e). The generated file contains all original data records listed in (a), but now with basin information listed in the data file (e). The intersect analysis created a new shapefile dataset named "Eligible Parcels in RainWise Basins with Basin Info", referred to as dataset (g). Please note that geodata files (b) and (c) do not need added basin information since those data files are specifically associated with the Barton Fauntleroy and East Ballard/West Phinney basins, respectively.
5. We cleaned datasets (a), (b), and (g) by finding all identical records and deleting all duplicate records. The SPU RainWise provided data contains duplicate records, and we were not informed of any data inconsistencies.
6. We appended the cleaned datasets (a), (b), and (g) into a single dataset. The combined dataset will contain all RainWise eligible (cistern, rain garden, or both) parcels within each CSO basin. In addition, the process created a new shapefile dataset named "Eligible Parcels in RainWise Basins with Basin Info Append", referred to as dataset (h). The dataset contains 74,449 records that include several parcel types, including single-family (residential use/zone), duplexes, or residential condominiums. Tables **??** through **??** provides summary statistics for the combined dataset.
7. We cleaned dataset (h) by finding all identical records and deleting all duplicate records.
8. We performed an intersect analysis (i.e., geometric intersection) between geodata files (h) (feature point) and (f). The feature point in the geodata file (h) will intersect (overlap) with the geocoded parcel polygons in the file (f). The generated file will contain RainWise eligible records listed in vii, but King County parcel characteristics information. The intersect analysis will create a new shapefile (i) dataset named "RainWise_Eligible_Parcels_with_KC_Info".

Please note that due to data inconsistencies in the SPU datasets, not all RainWise eligible records will be found in the newly created dataset. This mismatch is due to the SPU datasets including a parcel record that does not exist in the King County parcel records (i.e., dataset (f)).

9. We cleaned the (i) dataset by finding all identical records and deleting all duplicate records.

10. We converted geodata files (f) from its original polygon state to a feature point inside the featured polygon. The conversion will create a new shapefile (j) dataset named "King County Adoption Parcel Record Point".

11. We added X and Y coordinate information to dataset (j). POINT_X and POINT_Y will be calculated for each input feature point in dataset ix.

12. We joined the X (POINT_X) and Y (POINT_Y) from the dataset (j) to dataset (i) by the unique King County Parcel Identification Number (PIN) listed in each dataset.

13. We copied and exported the updated (i) dataset and created the following (k) dataset, "RainWise_Eligible_Parcels_with_KC_Info_XY".

14. We created a new point feature layer based on King County POINT_X, and POINT_Y defined coordinates in the (k) dataset. The layer created by this tool is temporary. After the creation, export and save the newly created layer as (l) dataset, "RainWise_Eligible_Parcels_Final".

15. We cleaned the (l) dataset by finding all identical records and deleting all duplicate records.

16. We calculate the distances in miles between datasets, (l) (input feature) and (j) (near feature), i.e., we performed a near table analysis using the Generate Near Table in the Analysis Tools toolbox. We specified a search radius of 0.5 miles and limited the number of nearby feature points to 100. The generated near table is named "RainWise Eligible Near Table".

17. Similar steps were performed for cleaning and preparing the RainWise adoption records (i.e., defaulting to King County parcel identification information, including PIN and latitude and longitude coordinates). The cleaned and prepared dataset is named "RainWise_Adoptions".

18. The final GIS-related step was exporting the following datasets as comma-separated value (.csv) files:

    (a) RainWise_Near_Table
    (b) RainWise_Eligible_Parcels_Final
    (c) King_County_Adoption_Parcel_Record_Point
    (d) RainWise_Combined_Sewer_Outfall_(CSO)_Basin_Record
    (e) RainWise_Adoptions

Table A.14: Parcel Type Summary

Parcel Type	Count
4-Plex	376
Apartment	1,598
Apartment(Co-op)	7
Apartment(Mixed Use)	430
Apartment(Subsidized)	30
Church/Welfare/Relig Srvc	177
Club	13
Condominium(Mixed Use)	87
Condominium(Residential)	462
Duplex	1,790
Group Home	18
Retail Store	487
Rooming House	139
School(Private)	45
School(Public)	60
Single Family(C/I Use)	49
Single Family(C/I Zone)	837
Single Family(Res Use/Zone)	55,220
Townhouse Plat	6,477
Triplex	620
Vacant(Multi-family)	169
Vacant(Single-family)	1,189
Art Gallery/Museum/Soc Srvc	7
Auditorium//Assembly Bldg	6
Auto Showroom and Lot	9
Bank	27
Bed & Breakfast	1
Car Wash	2
Condominium(Office)	3
Conv Store with Gas	29
Conv Store without Gas	13
Daycare Center	15
Easement	3
Total	**70,395**

Table A.15: Parcel Type Summary (Cont.)

Parcel Type	Count
Fraternity/Sorority House	51
Gas Station	1
Golf Course	13
Governmental Service	34
Greenhse/Nrsry/Hort Srvc	1
Grocery Store	26
Health Club	5
Historic Prop(Misc)	1
Historic Prop(Office)	14
Historic Prop(Residence)	3
Historic Prop(Retail)	1
Historic Prop(Vacant Land)	2
Hospital	4
Hotel/Motel	27
Houseboat	9
Industrial Park	1
Industrial(Gen Purpose)	44
Industrial(Heavy)	9
Industrial(Lignt)	42
Marina	7
Medical/Dental Office	55
Mini Lube	2
Mini Warehouse	11
Mobile Home	1
Mortuary/Cemetery/Crematory	6
Movie Theater	1
Nursing Home	7
Office Building	338
Open Space(Curr Use-RCW 84.34)	1
Park, Private(Amuse Ctr)	2
Park, Public(Zoo/Arbor)	95
Parking(Assoc)	120
Total	**934**

Table A.16: Parcel Type Summary (Cont.)

Parcel Type	Count
Parking(Commercial Lot)	44
Parking(Garage)	8
Post Office/Post Service	5
Rehabilitation Center	4
Residence Hall/Dorm	4
Restaurant(Fast Food)	27
Restaurant/Lounge	138
Retail(Big Box)	3
Retail(Discount)	3
Retail(Line/Strip)	43
Retirement Facility	16
Right of Way/Utility, Road	25
Service Building	100
Service Station	9
Shell Structure	15
Shopping Ctr(Maj Retail)	2
Shopping Ctr(Nghbrhood)	2
Skating Rink(Ice/Roller)	1
Sport Facility	7
Tavern/Lounge	17
Terminal(Auto/Bus/Other)	2
Terminal(Marine)	1
Tideland, 1st Class	3
Tideland, 2nd Class	1
Transferable Dev Rights	1
Utility, Private(Radio/T.V.)	2
Utility, Public	38
Vacant(Commercial)	188
Vacant(Industrial)	48
Vet/Animal Control Srvc	11
Warehouse	131
Unknown	221
Total	**1,120**

C.3 Create RainWise Peer Datasets using R

The exported GIS datasets in comma-separated value (CSV) format are loaded into RStudio 2022.07.2 Build 576 to prepare the data for final panel dataset creation. Refer to the R files, *clean_peer_effects.R* and *clean_peer_effects_cap.R*, for the complete dataset creation process. We conducted and implemented quality assurance and control reviews throughout the process to maintain the data's accuracy and consistency.

D Google Street View Data Creation

D.1 Clean and Prepare the Dataset

We use the following process to prepare the final Google Street View dataset on GSI visibility and sign placement. For each RainWise adoption (i.e., RainWise Adoption Parcel Records), we had three different raters use Google Street View and code the adopting property as having visible GSI (i.e., rain garden, cistern, or both) and whether the property displayed a RainWise sign – a sign promoting that the household had participated in the RainWise program. The raters' used the listed RainWise adoption record address to view each property in street view. The RainWise program provided the sign, but we are unaware as to when the sign was provided during the adoption process. The sign placement variables indicated whether the property had a sign, the nearest image year according to the street view, the first year with no sign, and each year the property displayed a sign over seven years. The raters were able to determine GSI visibility and sign placement changes after the initial adoption year. During this process, the raters did not know the type of GSI adopted. However, the raters did know when adoption occurred via the installation year.

The raters' data was then checked for discrepancies. Five hundred ninety-seven adoption records were flagged as having visibility or sign data entry discrepancies. Additionally, 42 adoption records were missing from the street view datasets. These records were hand checked using the same instructions given to the raters. The records were viewed using only the provided address and installation year to minimize rater bias. However, measurement error is still relevant, given the rater subjectivity during the process.

The RainWise adoption records given to the raters included the original parcel identification number (PIN) provided by SPU. The original PIN was matched to a (defaulting) King County PIN to maintain consistency during the panel dataset creation process – refer to Section **??**. The cleaned dataset was saved as a comma-separated value (.csv) file named "gsv_final.csv".

D.2 Create Google Street View RainWise Peer Datasets using R

All comma-separated value (.csv) formatted files plus the newly created Google Street View RainWise adoptions file are loaded into RStudio 2022.07.2 Build 576 to prepare the data for final Google Street View panel dataset creation. Refer to the R files, *gsv.R* and *gsv_cap.R*, for the complete dataset creation process. We conducted and implemented quality assurance and control reviews throughout the process to maintain the data's accuracy and consistency.