MCC Jordan Compact

Impact Evaluation (IE)
Component 1 Baseline Report

MARCH 8 2016 – AMMAN

SOCIAL IMPACT

Overview

1) **Brief reminder of what the IE aims to measure**
2) Design of Component 1
3) Baseline results
4) Concerns and recommendations

Reminder of Overall Evaluation Objective

Primary objective: Did the interventions reduce poverty and increase household income in Zarqa? What are the other economic impacts of the investments (on enterprises, farmers, utility performance, others outside Zarqa, etc.)

IE Design & Methods: Three Components

IE Component 1: Impacts of infrastructure improvements on urban households and enterprises in Zarqa (WNP and WWNP)

Methods**:** Use matching to select survey zones, conduct surveys to track outcomes over time

IE Component 2: Impacts on irrigators downstream of As Samra treatment plant (WNP; WWNP; and AEP) and water balance analysis

Methods**:** 1) Study natural experiment in JV and other agricultural areas, conduct longitudinal surveys to track outcomes over time; 2) Conduct water balance analysis to track substitution

IE Component 3: Changes at utility level in Zarqa

Methods**:** 1) Examine performance indicators at WAJ-Zarqa and other water utilities over time; 2) Conduct meter testing in Zarqa

Evaluation Objective (Continued)

Primary objective: Did the interventions reduce poverty and increase household income in Zarqa? What are the other economic impacts of the investments (on enterprises, farmers, utility performance, others outside Zarqa, etc.)

Main challenges to evaluation objectives:

1. Overlapping causal links (IE Logic): Important that we measure many things

Evaluation Objective (Continued)

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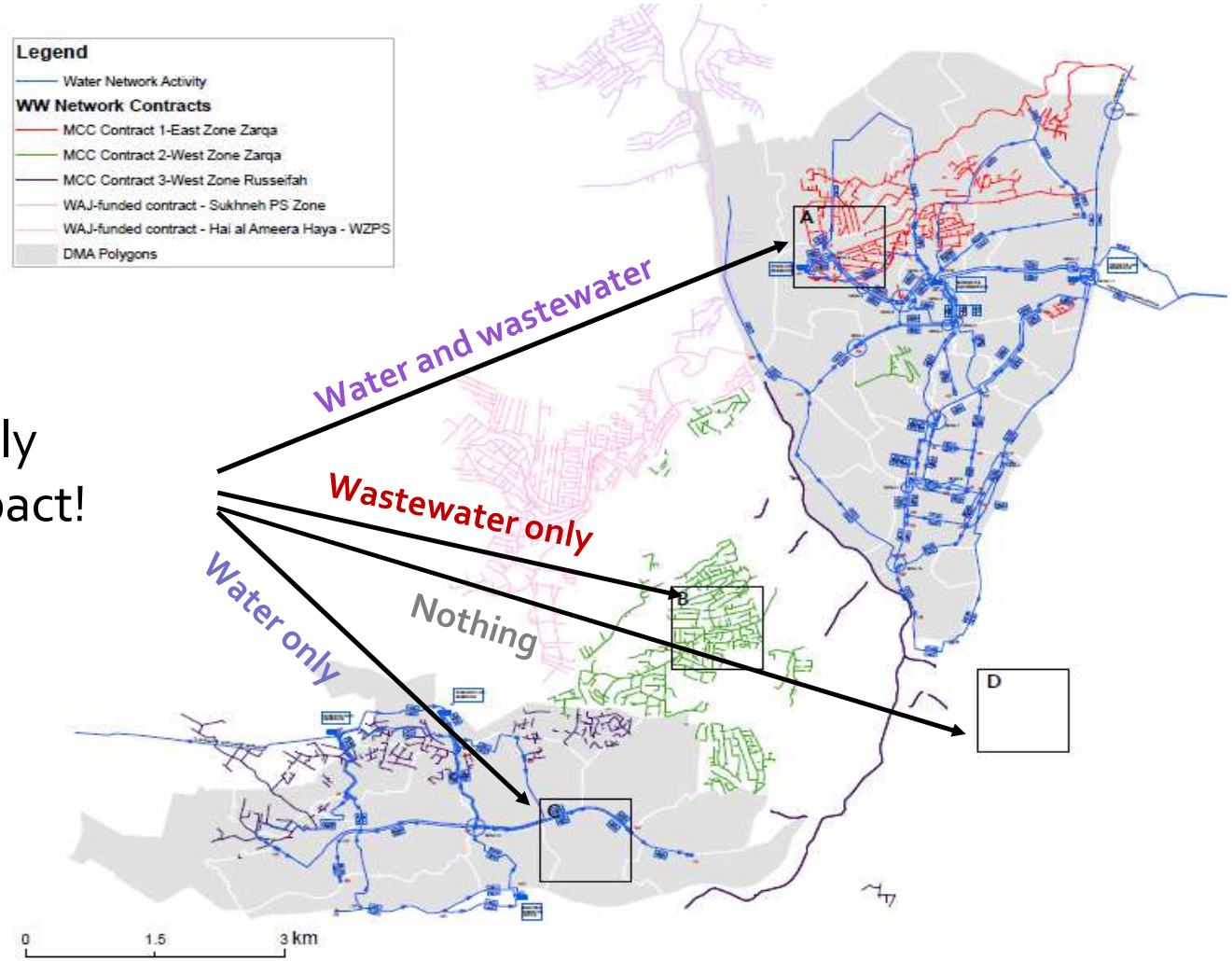
Main challenges to evaluation objectives:

1. Overlapping causal links (IE Logic): Important that we measure many things
2. Overlapping geographical areas (Implementation Map): Sampling must be carefully done

Implementation Map



Areas are differentially exposed to the Compact!

Evaluation Objective (Continued)

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Main challenges to evaluation objectives:

1. Overlapping causal links (IE Logic): Important that we measure many things
2. Overlapping geographical areas (Implementation Map): Sampling must be carefully done
3. Other ongoing developments (alternative explanations for changes, e.g. Disi water, general development trends)

Overview

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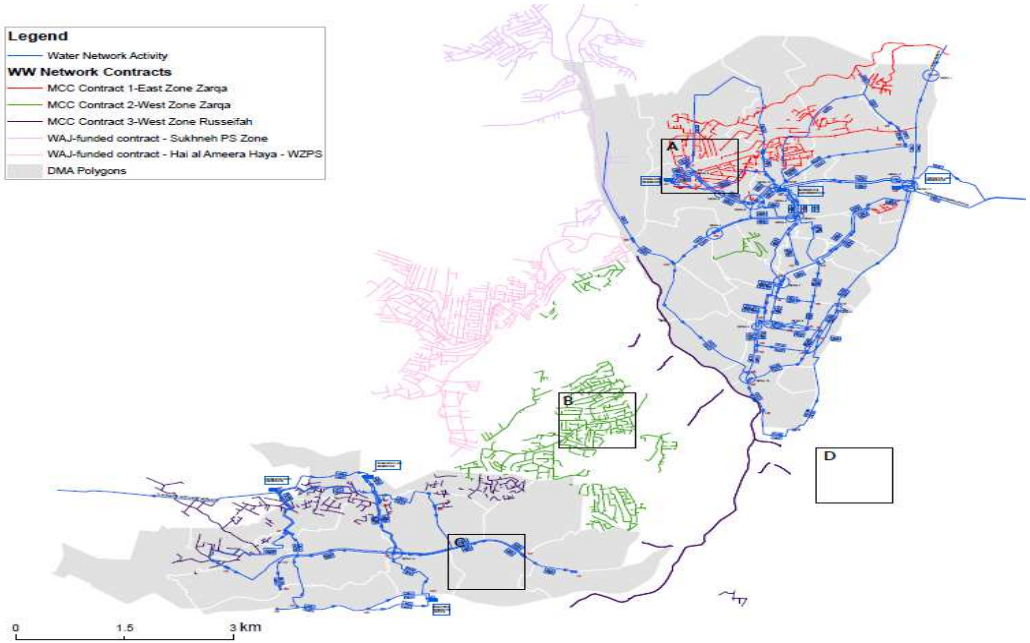
IE Component 1 Design (I): Sampling strategy

Water Wastewater	Treated	Control
Treated	A. Both improvements	B. Wastewater network only
Control	C. Water network only	D. No improvements

Used matching to select areas with similar Census characteristics **prior** to Compact interventions



IE C1 Design (I): Sampling
Reduce confounding w/matching

- **Method:** Matched on Census characteristics from 2004 (e.g., characteristics like education, population, income)
- We hope that PSM helps reduce the bias in the estimation of treatment effects by constructing similar treatment and control groups
- Since 2004 Census is somewhat dated, we also worked with DoS to **update the sampling frame**

IE C1 Design (I): Sampling

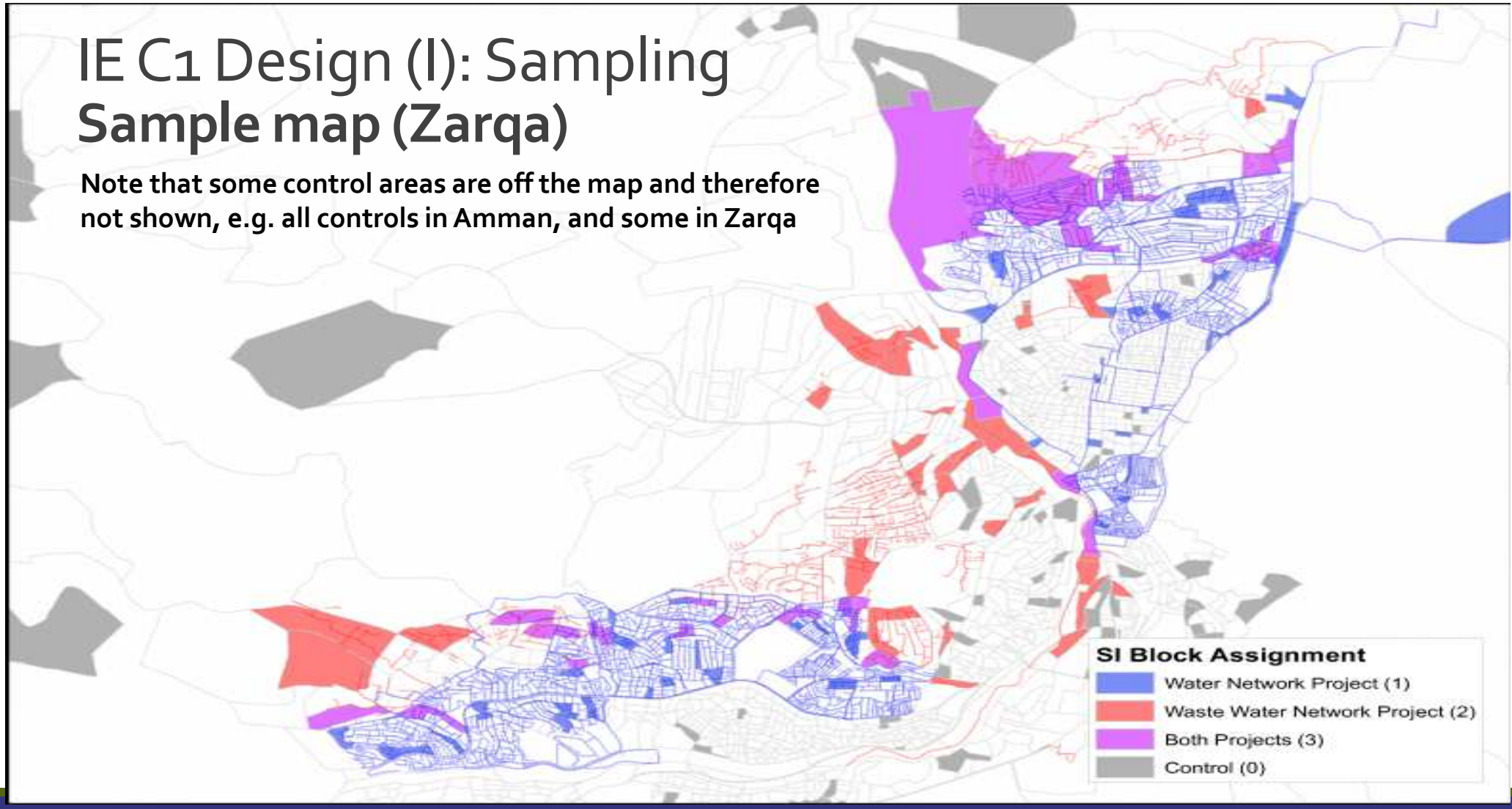
Many factors are related to treatment category

	Compared to Zarqa control			Compared to Amman control		
Variable	Treat WNP	Treat WWNP	Treat Both	Treat WNP	Treat WWNP	Treat Both
Pop. density		- - -	- - -	+ + +	- - -	- - -
# buildings	- - -	+ + +	+ + +	+ + +	+ + +	+ + +
# households	+ + +		- - -	- - -		- -
Male head of hh (%)				- -	+	
Handicap (%)	+ +			+ + +		
Non-Jordanian (%)	- - -	+ + +	+ + +	- - -	+	+ + +
Average residency (yrs)	- -	+ + +	- - -	+ + +	+ + +	- - -
Head>secondary educ. (%)		- -		+ + +		
Married head of hh (%)	- - -	+ +	+ + +	+ + +		+ + +
Head of hh is paid employee (%)		- -				
Wealth index	+ + +	- -		- - -	- -	

Notes: Number of **+ / -** signs indicates significance; blank cells indicate there is no statistically significant relationship. Additional details provided in the draft report.

IE C1 Design (I): Sampling
Sample map (Zarqa)

Note that some control areas are off the map and therefore not shown, e.g. all controls in Amman, and some in Zarqa



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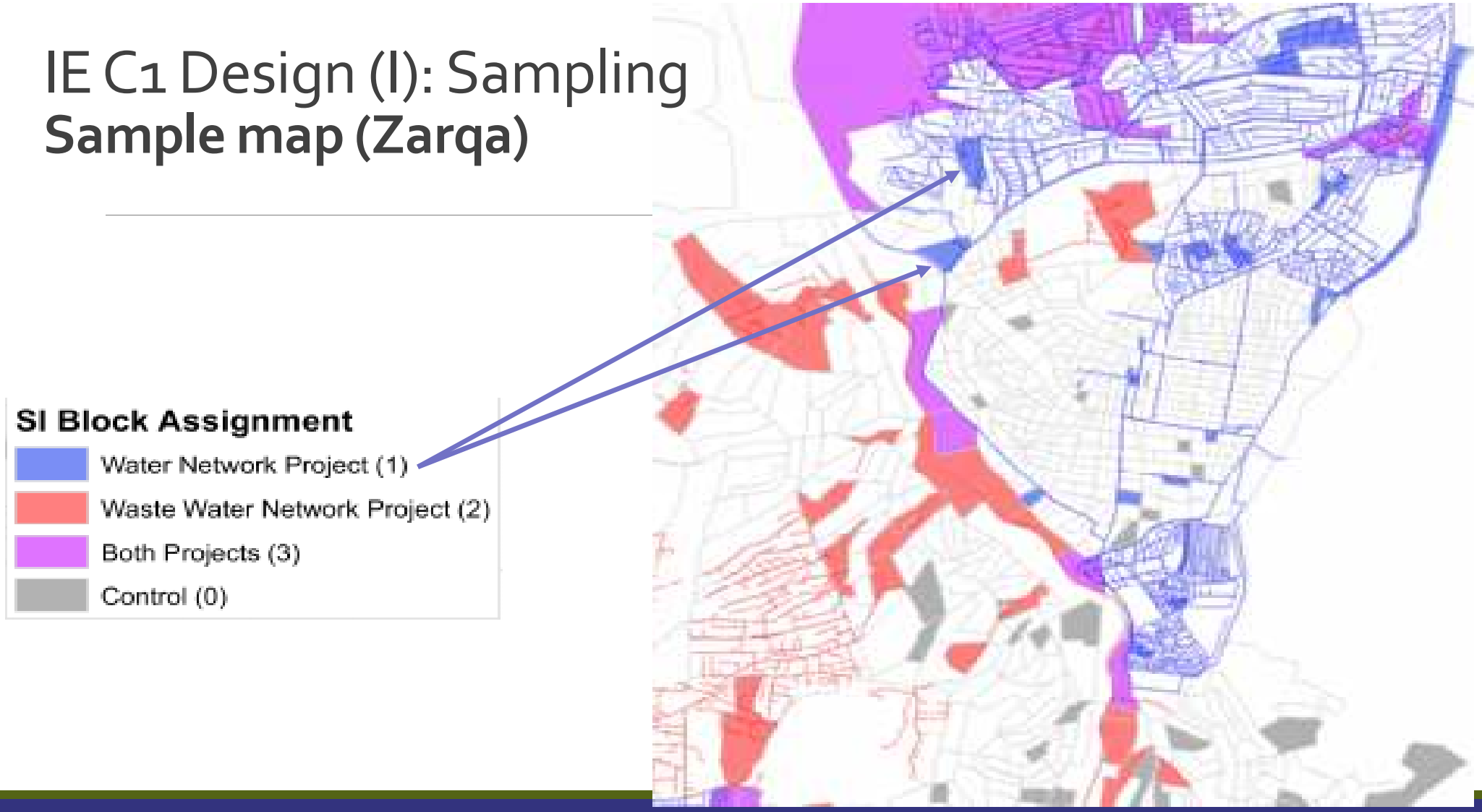

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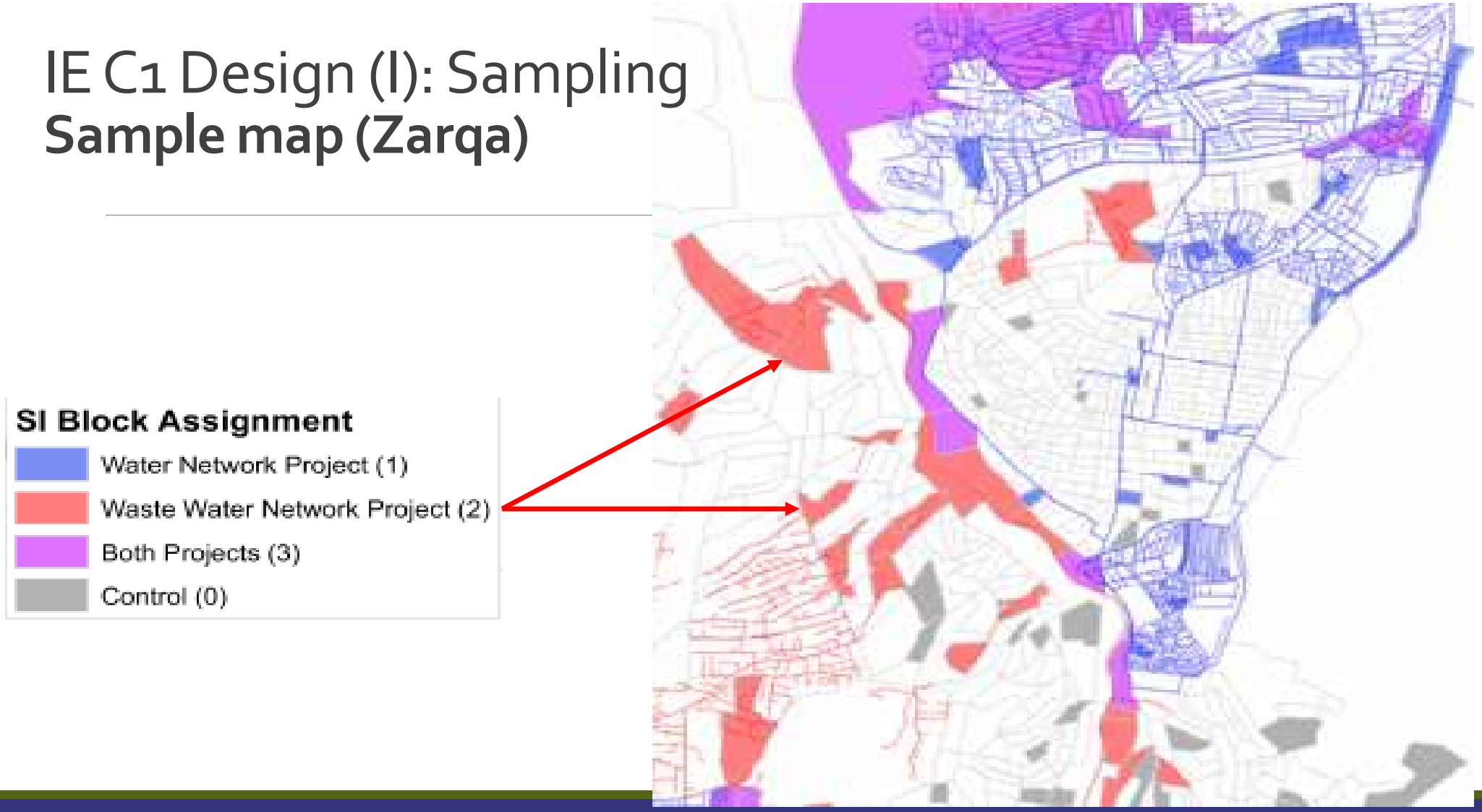

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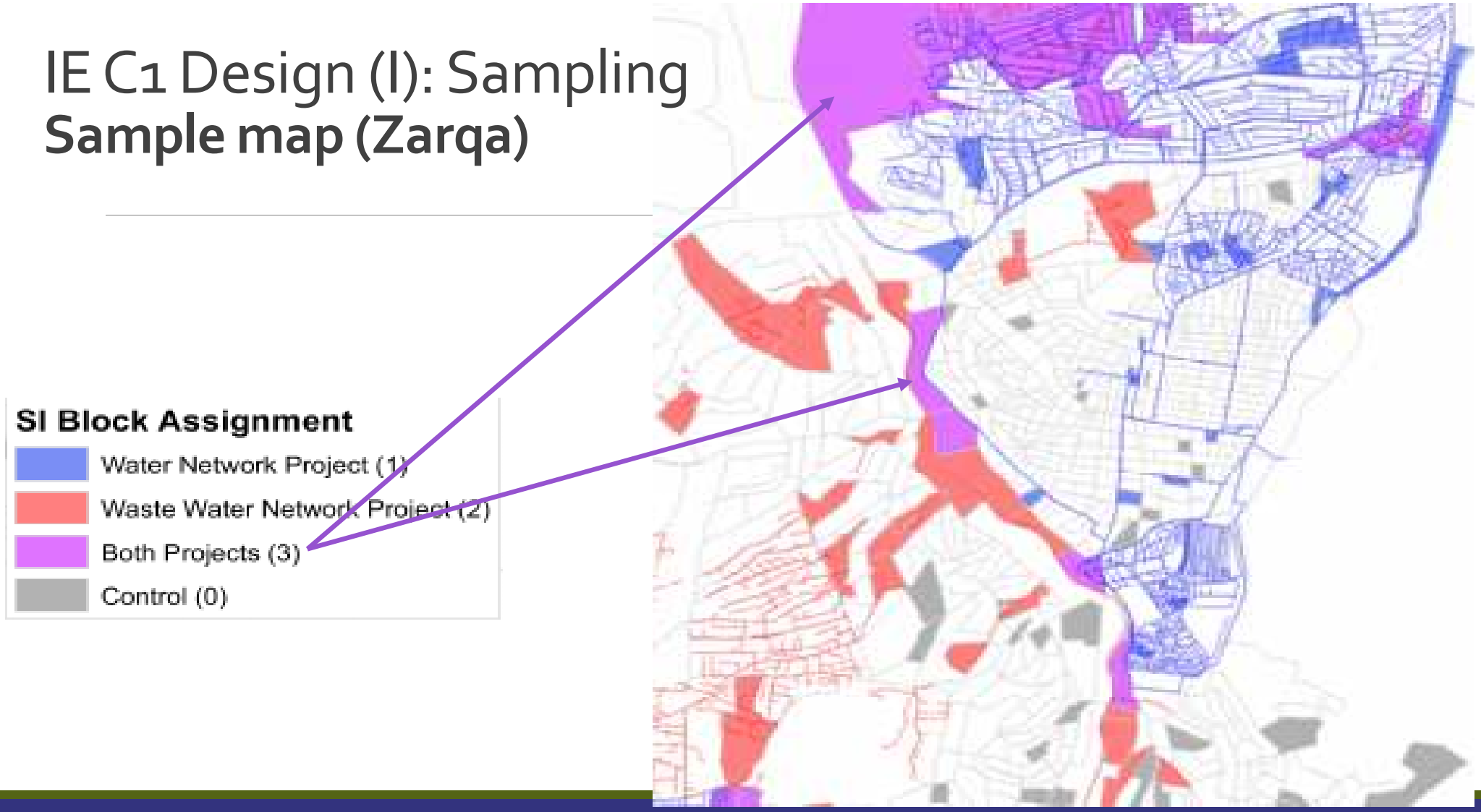

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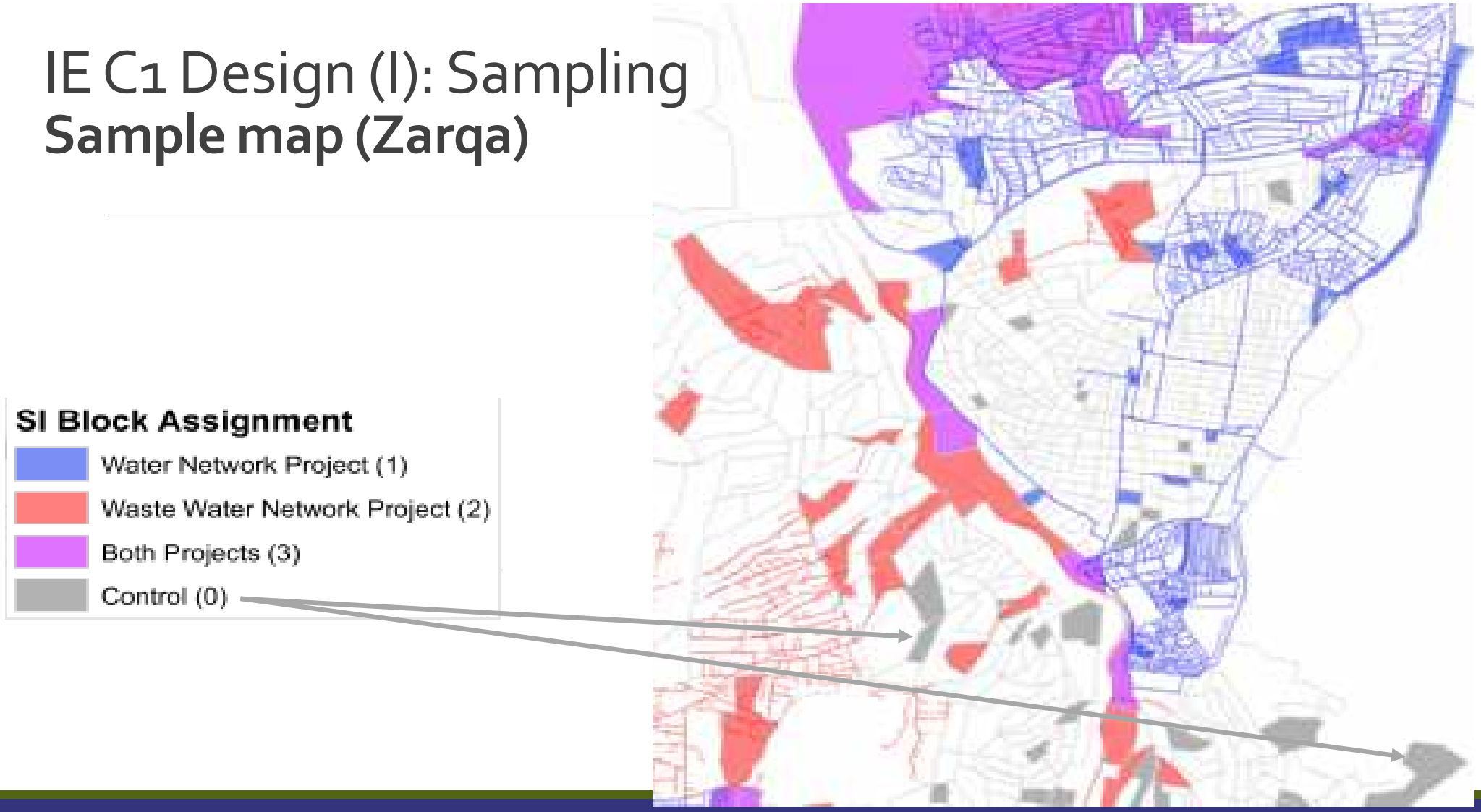
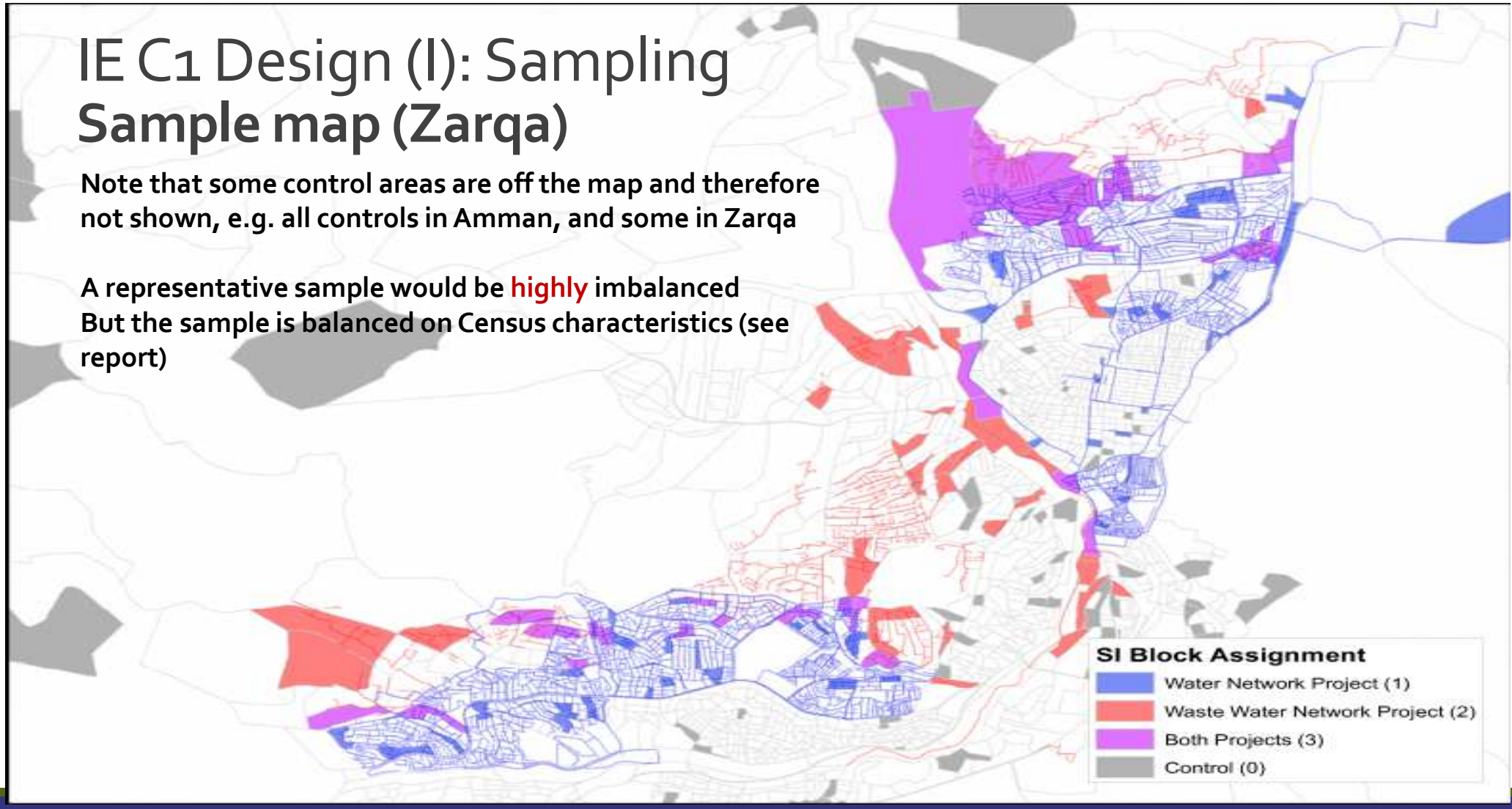


IE C1 Design (I): Sampling
Sample map (Zarqa)

Note that some control areas are off the map and therefore not shown, e.g. all controls in Amman, and some in Zarqa

A representative sample would be highly imbalanced
But the sample is balanced on Census characteristics (see report)



IE C1 Design (I): Sampling

Targeted (post sample design) distribution of households across arms

	Final target distribution of households	
	Blocks	Households
Zarqa Wastewater	43	473
Zarqa Water	49	539
Zarqa Both	43	473
Zarqa Control	82	902
Amman Control	108	1188
Total	325	3575

Notes: Final target sample sizes vary due to quality of matches across arms. For example, the controls in Amman do not match as well across arms as those in Zarqa, hence more blocks were needed to maintain balance on Census characteristics

IE C1 Design (II): Survey types / data sources

Data source	Population of interest & unit of analysis	Temporality	Coverage	Type of data	Target N
Household survey	All households in sample blocks	Panel (only baseline so far)	Non-representative, possible to reweight	Quantitative	3,575 households
Enterprise survey	All enterprises in sample blocks	Panel (only baseline so far)	Non-representative, possible to reweight	Quantitative	375 enterprises

Notes: On the basis of the experience in the household survey (with some loss of sample), a target of 425 enterprises was given to DoS so as to not negatively impact our target sample size.

IE C1 Design (III): Key variables & indicators
Summary of key intermediate outcomes

Outcome	Survey	Indicator
Increased water service	Household & enterprise	-Hours of supply/week -#, frequency & duration for supply interruptions -Customer complaints about reliability
Improved sewer service	Household & enterprise	-# of sewer customers -Volume of wastewater flowing to As-Samra from Zarqa -Customer complaints about sewer failures
Improved in-home water quality	Household	-*E. coli or thermo-tolerant coliform* counts at household -Perceptions of network water quality -Customer complaints about water quality
Increased water consumption	Household & enterprise	-Metered consumption (hh and overall) -Quantity of shop/tanker water purchased

IE C1 Design (III): Key variables & indicators
Summary of key final outcomes

Outcome	Survey	Indicator
Consumer cost savings	Household & enterprise	-Expenditure: Shop, tanker, network, other water -Expenditure for septic pumping -Expenditure for sewage connection & septic systems
Consumer time savings	Household & enterprise	-Time spent collecting water -Time spent maintaining sanitation -Other time expenses related to water supply
Increased productivity / capital accumulation	Household & enterprise	-Household/enterprise income & expenditure -Asset ownership -Improved educational status
Aesthetic (quality of life) benefits	Household	-Satisfaction with water supply -Improved household hygiene -Non-productive water use
Reduced economic burden of disease	Household	-Diarrheal disease; work/school days lost; water treatment cost

Overview

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2) Design of Component 1
3) **Baseline results**
4) Concerns and recommendations

Baseline results (I): HH sample descriptive statistics

	Overall			Zarqa sub-sample		
	N	Mean	(SD)	N	Mean	(SD)
Household Size	3359	4.91	(2.05)	2259	4.91	(2.03)
Female head of household	3359	0.15	(0.36)	2259	0.14	(0.35)
Jordanian	3359	0.93	(0.25)	2259	0.93	(0.26)
Resident of Zarqa	3359	0.67	(0.47)	n.a.	n.a.	
Average years of adult education	3359	10.6	(3.45)	2259	10.6	(3.33)
Home is an apartment/flat	3359	0.55	(0.50)	2259	0.56	(0.50)
# rooms	3358	4.24	(3.57)	2258	4.19	(4.27)
Homeowner	3359	0.73	(0.44)	2259	0.74	(0.44)
Total expenditure (JD/month)	3272	450	(341)	2191	429	(297)
NAF recipient	3351	0.027	(0.16)	2253	0.026	(0.16)
# of HH members w/diarrhea, past 2 wks.	3359	0.15	(0.53)	2259	0.15	(0.56)

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Baseline results (I): HH sample descriptive statistics

What can we say about this sample?

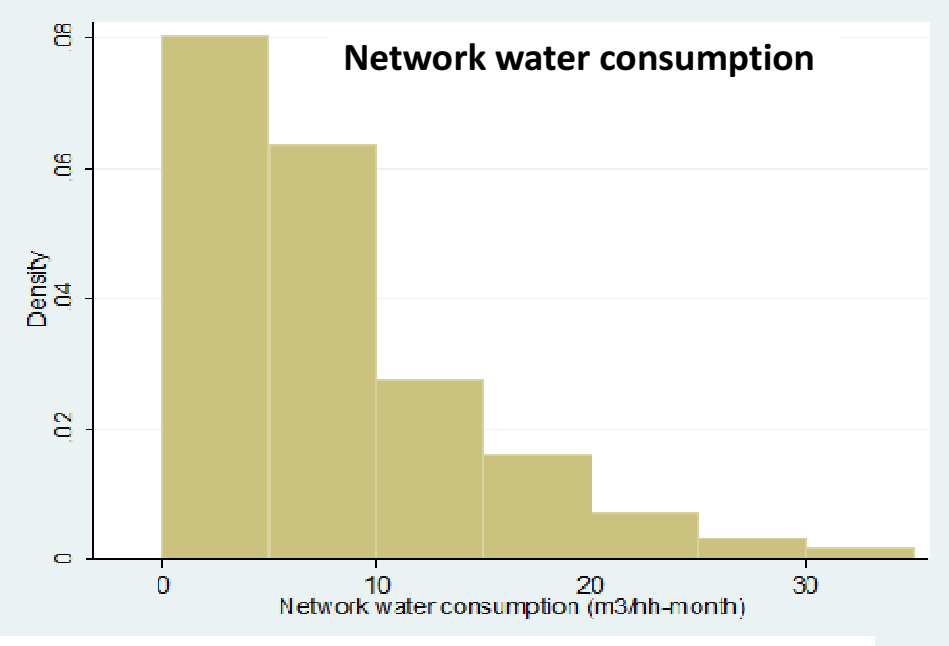
DoS 2009 Water Survey (representative) is the main point of comparison

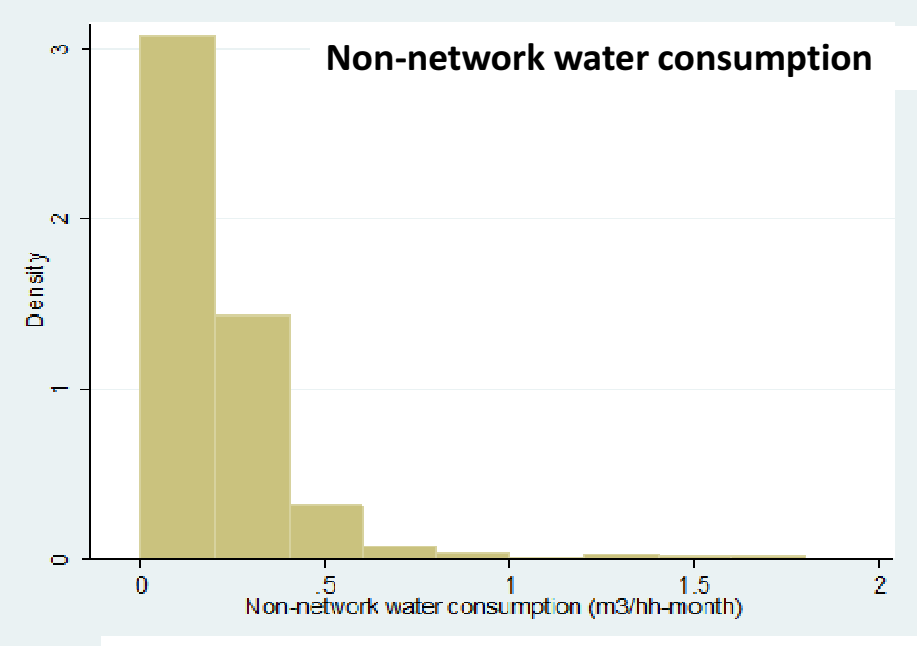
Variable	Our sample	DoS 2009 survey
Household size	4.9	5.4
Monthly expenditure (2014US$)	429	391
Live in flat/apartment	56%	60%
Have WAJ water	96%	97%
Have WAJ sewer	81%	85%
Report water-related health concerns	19%	15%
Use shop water	37%	34%
Days of piped water supply per month	8.3	9.5

Our sample has somewhat smaller and richer households, but is fairly representative

Baseline results (II): HH water and sanitation

Water consumption





Notes: Note differences in scale on two x-axes

Mean = 7.7 m^3/month

Total observations = 2550 (out of 3258 w/water connections); 22% missing (3% due to outliers)

Mean = 0.38 m^3/month

Total observations = 3359 (1478 use non-network sources)

Baseline results (II): HH water and sanitation

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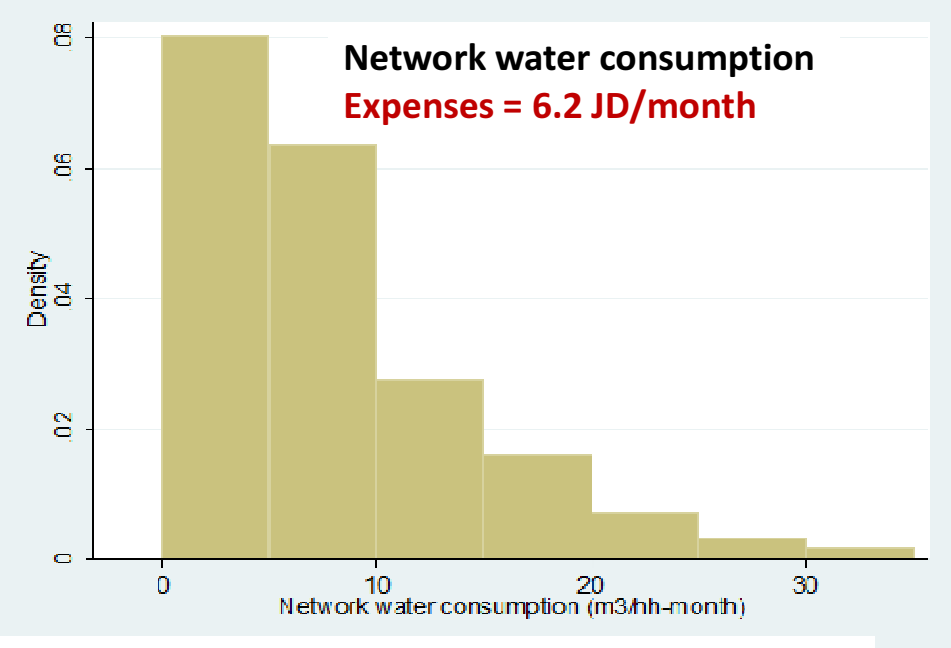

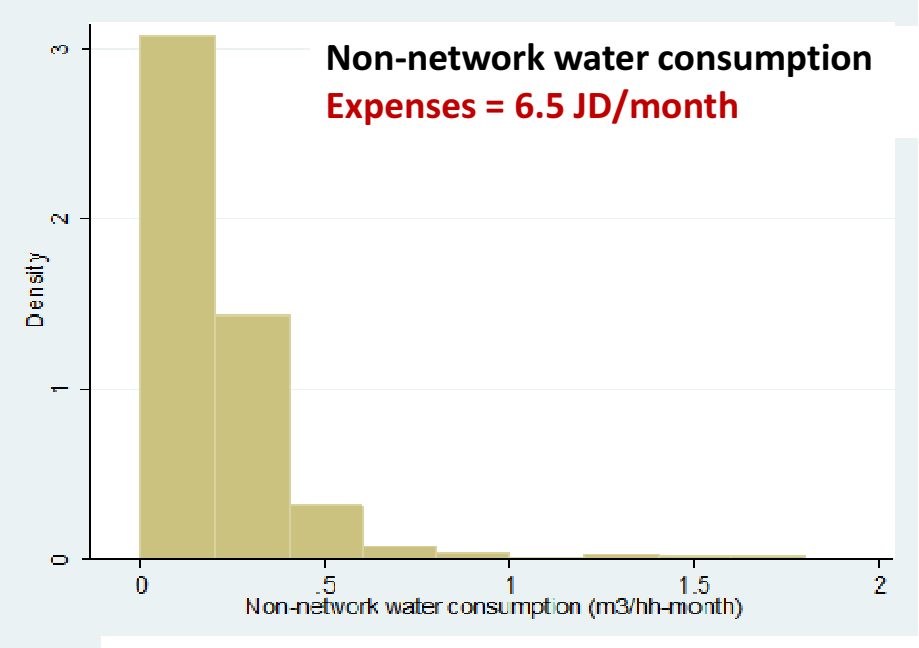

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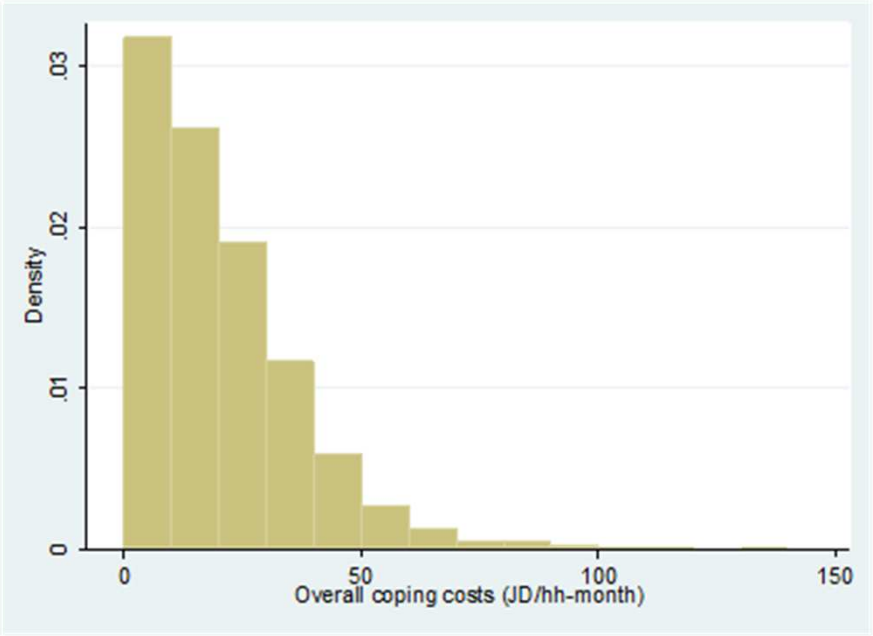
Baseline results (II): HH water and sanitation

Coping costs



Coping costs include:

1) Non-WAJ water expenditures **(6.5 JD/hh-month)**
2) Time spent collection non-WAJ water **(0.18)**
3) Repair costs - water infrastructure **(1.5)**
4) Water treatment costs **(2.0)**
5) Water storage costs **(1.4)**
6) Pit-emptying costs **(3.2)**
7) Toilet time costs (for those sharing toilets) **(0.22)**
8) Toilet infrastructure costs **(6.5)**

Notes:
Mean = 21.4 (N=3359)

Water Sample Tests – Summary of results

- *# of samples* = 426 (from 239 households, all from **stored tap / shop water**, or from **taps behind the meter**)
- *E. coli:*
  - **Below detection for all tap water samples** (<1 colony-forming unit / 100 mL sample)
  - **Mostly below detection in stored shop water samples**: 3 (of 91) shop water samples showed modest contamination (7, 28, and 54 CFU/100mL).
- *Total coliform*
  - **In ~10% of the tap water samples**; but only one >100 CFU /100mL
  - **In >70% of stored shop water samples**; 29% >100 CFU/100mL and 11% >1000 CFU/100mL

Baseline results (III): Enterprise sample descriptive statistics

	Overall			Zarqa sub-sample		
Variable	N	Mean	(SD)	N	Mean	(SD)
Firm is a sole proprietorship	345	0.87	(0.34)	281	0.87	(0.33)
Firm is a general partnership	345	0.084	(0.28)	281	0.068	(0.25)
Total employees	341	5.09	(11.0)	277	5.09	(11.4)
Years of owner experience	341	15.3	(10.1)	277	14.9	(10.2)
Business owner is female	343	0.079	(0.27)	279	0.082	(0.28)
Business owner monthly income	151	666	(629)	124	599	(470)
Water reliability is an obstacle to growth (1 = not at all; 5 = very big obstacle)	341	3.06	(1.19)	278	2.91	(1.15)
Water cost is an obstacle to growth (1 = not at all; 5 = very big obstacle)	341	3.65	(1.15)	278	3.55	(1.16)
Market value of buildings ('000 JD)	250	54.9	(203)	197	56.4	(224)
Total monthly sales ('000 JD)	271	8.56	(26.5)	230	9.35	(28.1)
Monthly labor cost ('000 JD)	240	1.79	(4.12)	195	1.84	(4.38)

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Baseline results (III): Enterprise sample descriptive statistics

What can we say about this sample?

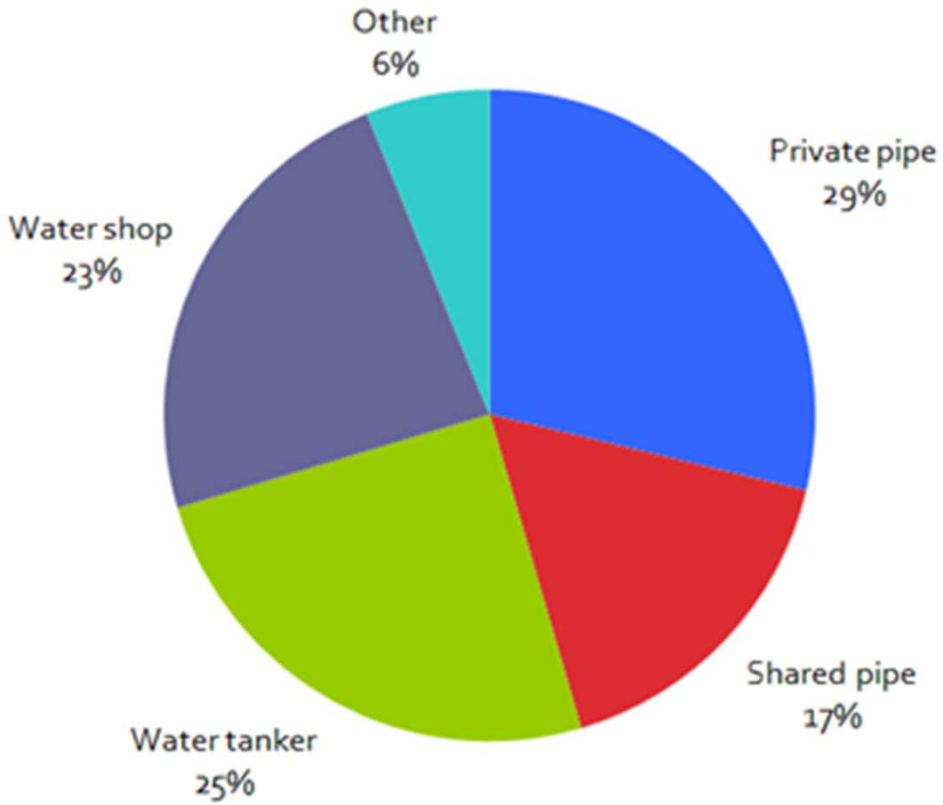
World Bank Enterprise Surveys (also non-representative) are the main comparison

Variable	Our sample	World Bank sample (re-weighted)
Years of owner experience	14.9	19.4
% of firms with female owners	9%	8%
Sole proprietorship	87%	54%
Firm is a partnership	7%	36%
Proportion of unskilled workers	37%	16%
% of female workers	20%	13%
Firm has a checking account	24%	81%
Firm has piped water	28%	26%

Our sample has smaller and less skilled enterprises with fewer assets

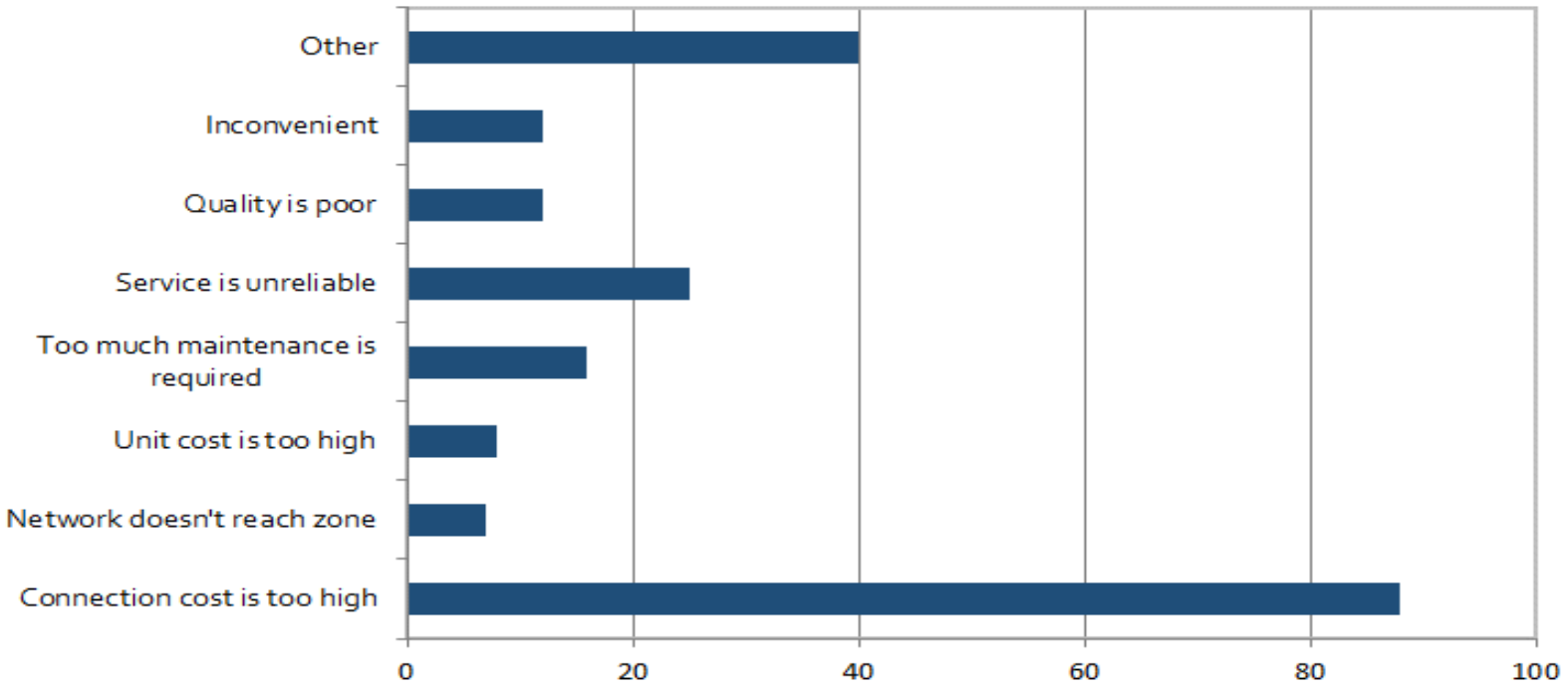
Baseline results (IV): Enterprise water and sanitation

Reported main source of water



Baseline results (IV): Enterprise water and sanitation

Reasons why enterprises do not use piped water



Baseline results (IV): Enterprise water and sanitation

Statistics

	Overall			Zarqa sub-sample		
Variable	**N**	**Mean**	**(SD)**	**N**	**Mean**	**(SD)**
Use private piped water	341	0.30	(0.46)	278	0.28	(0.45)
Use water shops	341	0.26	(0.44)	278	0.27	(0.44)
Use water tankers	341	0.43	(0.50)	278	0.45	(0.50)
Monthly cost of water	341	57.2	(114)	277	58.1	(118)
Firm stores water	341	0.72	(0.45)	277	0.70	(0.46)
Amount of stored water (m3)	341	3.62	(6.97)	277	3.36	(5.87)
Days of piped water per month	163	7.88	(4.93)	130	8.45	(5.07)
Business has wastewater management	341	0.69	(0.46)	278	0.68	(0.47)
Wastewater goes to sewer	234	0.93	(0.25)	190	0.92	(0.28)

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4) **Concerns and recommendations**

Main concerns

1) Internal validity of the evaluation
   a) Measurement problems
   b) Sample balance problems
   c) Known confounders
2) External validity of the sample
3) Statistical power

Concerns (I): Internal validity

Measurement problems

Details are available in our report, but main problems relate to…

- Household expenses on network water (missing or misreported data)
- HH underreporting of non-network sources, particularly tankers
- Enterprise costs (wages and other categories)

→ **Recommendations**: Seasonal survey and higher frequency data collection for households, still in discussion about enterprises

Concerns (I): Internal validity

Threats to inference: Sample balance

Some **imbalance in household survey** (more details in report) suggest that there are differences between WNP areas / WWNP areas and Control areas

This will make it hard to really know if observed changes are because of the Compact

Enterprise survey balance looks better (only slightly more imbalance than expected by chance).

→ **Recommendations**: Use higher frequency data collection for households; use better statistics

Concerns (I): Internal validity

Threats to inference: Known confounders

We know about 3 major non-Compact confounders:

- Evolving Syrian refugee situation
- Arrival of Disi water
- Utility restructuring in Zarqa (Miyahuna contract)

→ **Recommendations**: Strengthens the case for paying attention and devoting resources to IE Components 2 & 3 (water balance + utility monitoring); and for doing data collection on refugees

Concerns (II): External validity

Households sample looks representative

No major concerns, but our enterprise sample is different than World Bank enterprise survey sample

→ **Recommendations**: This issue deserves additional discussion, but statistical power is perhaps more important.

Concerns (III): Statistical power

Several issues:

1. Our hh sample arms are smaller than originally planned (challenge of obtaining good matches and survey completion rates)

	Proposed distribution (from EDR)			Final target distribution		Final distribution	
	N	Attrition	Total	Blocks	Households	Blocks	Households
Zarqa Wastewater	625	62.5	687.5	43	473	43	456
Zarqa Water	625	62.5	687.5	49	539	49	493
Zarqa Both	625	62.5	687.5	43	473	43	450
Zarqa Control	625	62.5	687.5	82	902	82	845
Amman Control	625	62.5	687.5	108	1188	108	1098
Total	3125	312.5	3440	325	3575	325	3359

Concerns (III): Statistical power

Several issues:

1. Our hh sample arms are smaller than originally planned (challenge of obtaining good matches and survey completion rates)
2. Data are more variable than expected (but perhaps can be cleaned better if we do high frequency data collection)
3. Comparisons across arms (e.g., WNP vs. WWNP) may lack power
4. Enterprise survey is underpowered

→ **Recommendations**: Replace households that attrit; implement additional data collection; consider increasing household sample size (more resources); discuss more enterprise survey work

Thanks!

Questions?

Extras

IE C1 Design (I): Sampling

Summary of pre-PSM balance (Zarqa)

Census Variable	Area A Both (N=104)	Area B WWNP only (N=115)	Area C WNP only (N=524)	Area D Controls (N=1303)
1. Wealth index	**-0.54*** **	-1.13	**-0.77*** **	-1.21
2. Marital status – head	**91.0%*** **	**90.8%*** **	87.2%	88.2%
3. Male head of household	**91.6%*** **	**92.4%*** **	**89.3%*** **	90.3%
4. Head > Secondary educ.	**45.3%*** **	36.8%	**42.8%*** **	38.1
5. Average residency	**14.2*** **	16.7	**16.7** **	16.2
6. Non-Jordanian	**6.2%***	7.7%	**4.9%*** **	8.4%
7. # buildings in block	39.0	**49.1*** **	**34.3*** **	39.5
8. Population density	**66.6*** **	**72.2*** **	**266.1** **	238.4
9. Paid employee – head	**78.6%***	**78.6%***	79.7%	80.6%
10. # households in block	**70.6*** **	**89.8***	85.3	83.1
11. Handicap	5.6%	5.6%	6.2%	5.9%

Notes: *** indicates p<0.01; ** p<0.05; *; p<0.1

IE C1 Design (I): Sampling

Summary of pre-PSM balance (Amman)

Census Variable	Area A Both (N=104)	Area B WWNP only (N=115)	Area C WNP only (N=524)	Area D Controls (N=1386)
1. Wealth index	**-0.54*** **	**-1.13*** **	**-0.77*** **	0.37
2. Marital status – head	**91.0%*** **	**90.8%*** **	87.2%	87.7%
3. Male head of household	**91.6%*** **	**92.4%*** **	89.3%	89.8%
4. Head > Secondary educ.	**45.3%*** **	**36.8%*** **	**42.8%*** **	53.4%
5. Average residency	**14.2*** **	**16.7*** **	**16.7*** **	13.0
6. Non-Jordanian	6.2%	7.7%	**4.9%*** **	7.6%
7. # buildings in block	**39.0*** **	**49.1*** **	**34.3*** **	30.6
8. Population density	**66.6*** **	**72.2*** **	**266.1*** **	177.4
9. Paid employee – head	**78.6%***	**78.6%***	**79.7%*** **	76.5%
10. # households in block	**70.6*** **	89.8	**85.3*** **	92.3
11. Handicap	**5.6%****	**5.6%****	**6.2%*** **	4.8%

Notes: *** indicates p<0.01; ** p<0.05; *; p<0.1

Summary of balance after PSM (Zarqa)

Census Variable	Area A Both	Area A Controls	Area B WWNP only	Area B Controls	Area C WNP only	Area C Controls
1. Wealth index	-0.25	-0.66	-0.94	-1.04	-1.08	-1.09
2. Marital status – head	89.1%	89.3%	89.5%	87.7%	88.4%	88.3%
3. Male head of household	90.1%	89.8%	90.1%	90.3%	90.2%	90.1%
4. Head > Secondary educ.	51.4%	47.2%	40.0%	38.3%	39.3%	38.6%
5. Average residency	15.9	15.9	16.7	17.2	16.3	16.7
6. Non-Jordanian	4.1%	4.3%	3.7%	4.7%	5.1%	5.0%
7. # buildings in block	35.1	37.6	**38.1****	45.6	36.1	36.0
8. Population density	98.4	118.2	113.5	160.2	278.6	251.7
9. Paid employee – head	80.3%	77.8%	81.5%	81.4%	80.9%	80.3%
10. # households in block	79.3	77.0	**83.7***	96.2	81.6	83.6
11. Handicap	4.5%	5.2%	5.7%	6.7%	6.2%	6.2%

Notes: *** indicates p<0.01; ** p<0.05; *; p<0.1

Summary of balance after PSM (Amman)

Census Variable	Area A Both	Area A Controls	Area B WWNP only	Area B Controls	Area C WNP only	Area C Controls
1. Wealth index	-0.30	-0.13	-0.94	-1.21	-0.30	-0.42
2. Marital status – head	90.0%	90.3%	88.5%	89.5%	88.3%	87.8%
3. Male head of household	89.8%	91.4%	90.7%	91.0%	89.6%	89.2%
4. Head > Secondary educ.	47.4%	45.8%	37.6%	34.4%	46.2%	45.3%
5. Average residency	14.6	15.9	16.1	17.1	14.9	14.7
6. Non-Jordanian	4.3%	4.3%	7.8%	5.0%	6.2%	5.9%
7. # buildings in block	37.1	33.1	39.6	36.2	32.4	33.2
8. Population density	90.1	84.4	96.3	116.8	192.8	200.4
9. Paid employee – head	77.5%	75.9%	79.2%	81.8%	77.3%	78.3%
10. # households in block	76.4	67.2	80.0	84.5	88.5	92.0
11. Handicap	5.9%	4.6%	5.6%	6.3%	5.0%	5.6%

Notes: *** indicates p<0.01; ** p<0.05; *; p<0.1

IE C1 Design (III): Key variables & indicators

Coping cost indicators

Coping Cost Type	Data Source	Assumptions	Formula
Non-network water expenditures	• Est. non-network water purchases (p_i)	None	$\sum_{i=1}^{7} p_i$
Water collection costs	• Est. of non-network collection time (t_i) • Est. of non-network quantity (q_i)	• One trip/wk • Value of time = average wage	$\sum_{i=1}^{7}(t_i/60) * w * 4$
Water treatment costs	• Est. of treatment costs (c) • Est. of equipment costs (e)	• 5 yr equipment lifespan • 5% discount rate	$c + \frac{e}{1.05^{5*12}}$
Water storage costs	• Est. cost to clean storage containers (S)	None	S
Expenses on in-house water repairs	• Est. of repair costs (r) • Est. of time for repairs (s)	• Value of time = average wage	$\frac{r+s*w}{12}$
Toilet cleaning costs	• Est. of time for cleaning toilets (c)	None	c
Toilet infrastructure	• Est. of costs to replace toilet (r) • Reported connection fees (w)	• 20 yr lifespan of toilet • 5% discount rate	$(0.08 * (r + w))/12$
Time spent on trips to toilet	• Est. of time spent walking to toilet for households with shared toilets (t)	• Value of time = average wage • 3 trips/day per person	$\left(\frac{t}{60}\right) * w * 3h$
Pit emptying costs	• Cost of emptying pit (p) • Frequency of emptying pit (m)	None	$\frac{p}{12} * m$