

DOSPIR on ArcGIS Pro

User's Guide



Laboratory for Advanced Construction Technology

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1. Original data from Iowa DOT

a. Crash Data

- Data obtained from

<https://data.iowadot.gov/datasets/84cc3a98db944e71aed9e4a984a3ff60/explore>

- 792,337 total crashes from 2009 to 2023

ID	Shape	OBJECTID	CRASH_KEY	CASENUMBER	LOCUSNUM	CRASH_DATE	CRASH_MONT	CRASH_DAY	DISTRICT	COUNTY_NAME	CITY_NAME	SYSTEMNO	LITERAL	PRETHRM	LOCSTHRM	CCCRIMINAL	MAKSE	DRUGALC	CEINTORIC	LIGHT	CRFEND	WEATHER	CEINTORIC	RDTYPE	PAVTS	WRELATED	CRV	FRONTLTS	INJURES	MAININURY	MININURY	POSSINURY	UNINJURY	PREPONG	VEHICLES	OCCUPANTS	REPORT	3000RD	YCD
1	Point 204	2101401	200900001	2009420002	W09-00019	2009-07-01	1	5	2	7	0		WILCOX AVE & W.L.	33	1	5	2	0	1	1	1	2	1	12	1	0	4	0	1	0	0	1	0	1800	2	4	7	554504	470
2	Point 204	2101404	200900004	2009420003	000020	2009-07-01	1	7	4	25	0		US 169	33	1	5	20	0	2	5	3	6	2	1	1	0	2	0	2	0	0	0	1000	4	5	7	414001	462	
3	Point 204	2101473	200900003	2009420002	200900105	2009-07-01	1	7	1	64	0		SUNSET ST	33	4	2	44	0	2	5	3	2	2	1	1	0	3	0	1	0	1	0	3000	2	2	7	507504	465	
4	Point 204	2101474	200900000	2009420007	09-06	2009-07-01	1	7	1	77	0		E CARROLL DR	20	1	1	45	0	2	5	3	6	2	1	1	0	5	0	0	0	0	0	8000	1	4	7	457604	460	
5	Point 204	2101479	200900004	2009420042	200900075	2009-07-01	1	5	1	77	0		MCKENNA AVE	33	6	99	65	0	1	1	1	2	99	1	1	0	5	0	0	0	0	0	1800	2	1	7	499201	460	
6	Point 204	2101485	200900076	2009420041	09-0009	2009-07-04	1	1	1	94	0		CENTRAL AVE & S 13E...	33	1	5	30	0	1	4	3	1	2	12	1	0	5	0	0	0	0	0	6000	2	4	7	403401	470	
7	Point 204	2101486	200900040	2009420037	09-0024	2009-07-01	1	7	3	97	0		STONE AVE & W W T...	97	1	1	20	0	1	1	3	5	2	4	1	0	5	0	0	0	0	0	8000	1	1	7	224800	470	
8	Point 204	2101482	200900010	2009420036	09-00080	2009-07-01	1	7	3	97	0		S PETERSON ST	33	1	6	45	0	1	4	3	1	2	1	1	0	5	0	0	0	0	0	2000	2	777	7	224301	470	
9	Point 204	2101493	200900070	2009420023	0000004	2009-07-02	1	6	2	7	0		ETH ST & CAR ST	33	1	5	7	0	1	1	1	1	1	12	1	0	5	0	0	0	0	0	3000	2	4	7	543101	470	
10	Point 204	2101494	200900073	2009420040	W09-001544	2009-07-01	1	2	2	7	0		W RIDGEWAY AVE	33	1	2	9	0	1	1	1	1	1	4	1	0	4	0	2	0	0	2	3000	2	3	7	532700	470	
11	Point 204	2101507	200900040	2009420007	09-00080	2009-07-01	1	7	1	40	0		I-35	33	1	1	20	0	2	1	3	6	2	1	1	0	5	0	2	0	0	13000	1	3	5	433601	469		
12	Point 204	2101508	200900047	2009420090	09-000191	2009-07-04	1	1	1	40	0		Co Rd 625 COTNEY ST	44	1	1	20	0	1	1	3	1	2	1	1	0	5	0	2	0	1	1	0	4000	1	3	7	439200	470
13	Point 204	2101509	200900040	2009420000	200900007	2009-07-01	1	7	5	31	0		W 47th ST	33	1	5	10	0	1	1	1	2	1	4	1	0	5	0	0	0	0	0	1800	2	3	7	580701	454	
14	Point 204	2101510	200900026	2009420036	200900051	2009-07-01	1	6	1	77	0		US 69 & 14th ST & E...	33	1	5	24	0	1	1	1	1	1	4	1	0	4	0	2	0	0	6000	3	9	7	430304	460		
15	Point 204	2101511	200900030	2009420003	09-00451	2009-07-05	1	2	4	70	0		I-29	33	1	5	71	0	1	1	1	1	1	20	1	0	5	0	0	0	0	0	4000	2	2	7	257401	456	
16	Point 204	2101521	200900024	2009420020	09-000167	2009-07-01	1	7	1	85	0		ETH ST & DOUGLAS AVE	33	1	5	45	0	2	1	3	6	2	12	1	0	4	0	2	0	0	2	5	7	449300	465			
17	Point 204	2101522	200900026	2009420031	09-0107	2009-07-05	1	2	1	85	0		LINCOLN DRING & S D...	33	1	5	5	0	1	1	2	1	1	15	1	0	5	0	0	0	0	0	6000	2	2	7	430300	465	
18	Point 204	2101525	200900039	2009420036	09-01029	2009-07-07	1	4	6	6	0		E 5TH ST & S 9TH AVE	33	4	7	16	0	1	1	4	2	2	1	1	0	5	0	0	0	0	4000	2	1	7	581401	466		
19	Point 204	2101536	200900047	2009420022	W09-001919	2009-07-06	1	5	2	7	0		MEADOW LN	33	1	2	70	0	1	1	4	1	1	1	1	0	5	0	0	0	0	0	8000	2	3	7	531501	470	
20	Point 204	2101537	200900020	2009420025	W09-001590	2009-07-01	1	2	2	7	0		SAGER AVE & DORRER...	43	1	1	20	0	1	1	3	1	1	12	1	0	5	0	0	0	0	0	2500	1	1	7	530601	470	
21	Point 204	2101540	200900030	2009420033	09-001401	2009-07-01	1	2	6	31	0		JOHN F KENNEDY RD	33	1	6	13	0	1	1	1	1	1	1	1	0	5	0	0	0	0	3000	2	2	7	687201	470		
22	Point 204	2101547	200900030	2009420030	09-000056	2009-07-01	1	7	1	40	0		US 20	20	1	1	20	0	2	1	3	6	2	1	1	0	5	0	0	0	0	0	1800	1	4	7	431901	469	
23	Point 204	2101548	200900031	2009420031	09-00001	2009-07-01	1	5	5	62	0		I-423	31	77	77	1	0	77	77	77	77	77	77	1	0	5	0	0	0	0	0	2000	1	777	7	531901	457	
24	Point 204	2101549	200900030	2009420030	200900070	2009-07-06	1	3	1	77	0		JOHN PETERSON RD...	33	1	5	7	0	1	1	3	2	2	12	1	0	5	0	0	0	0	0	2000	2	2	7	420801	460	
25	Point 204	2101550	200900039	2009420039	200900071	2009-07-04	1	1	1	77	0		SMITH ST	33	1	5	20	0	99	1	3	1	2	1	1	0	5	0	0	0	0	0	1800	2	777	7	444701	470	
26	Point 204	2101557	200900042	2009420038	09-0402	2009-07-06	1	3	3	97	0		MILLAR RD & CADDO...	33	1	5	9	0	1	3	1	2	1	96	1	0	5	0	0	0	0	0	7000	2	3	7	216901	471	
27	Point 204	2101560	200900040	2009420036	09-00117-A	2009-07-07	1	4	4	89	0		CORNING ST & BOUN...	33	1	5	24	0	90	1	6	2	2	12	1	0	5	0	0	0	0	0	1300	2	4	7	512301	454	
28	Point 204	2101569	200900047	2009420029	200900069	2009-07-06	1	5	1	77	0		E BARK AVE & S2 CONE...	33	1	4	71	0	1	1	1	1	1	12	1	0	5	0	0	0	0	0	5000	2	4	7	451401	460	
29	Point 204	2101570	200900042	2009420032	09-00141	2009-07-06	1	5	6	82	0		MIDDLE RD & MARQU...	33	1	99	71	0	1	1	1	1	1	15	1	0	5	0	0	0	0	0	2000	2	1	7	700000	460	
30	Point 204	2101571	200900045	2009420032	09-0005	2009-07-06	1	5	4	87	0		TOTEM ST	21	1	99	45	0	90	1	3	1	2	1	2	0	5	0	0	0	0	0	4000	1	1	7	530701	451	
31	Point 204	2101572	200900047	2009420039	2009-0003	2009-07-01	1	7	5	91	0		N HICHMAN ST	33	1	5	65	0	1	4	1	1	1	1	1	0	5	0	0	0	0	0	1700	2	3	7	433801	470	
32	Point 204	2101579	200900040	2009420034	200900077	2009-07-01	1	7	3	97	0		I-29	95	3	1	20	0	2	1	3	6	1	96	1	0	5	0	0	0	0	0	1300	1	1	7	222801	470	
33	Point 204	2101580	200900040	2009420032	200900003	2009-07-01	1	7	4	43	0		I-29	33	1	6	16	0	2	1	3	6	1	1	1	0	4	0	1	0	0	1	0	1800	2	2	7	249404	461
34	Point 204	2101581	200900040	2009420037	200900003	2009-07-04	1	1	2	96	0		CO 105	20	1	1	44	0	2	5	3	10	2	1	1	0	5	0	0	0	0	0	1800	1	2	7	463701	460	
35	Point 204	2101582	200900020	2009420033	W-09-0005	2009-07-05	1	5	2	5	0		I-49	33	1	4	71	0	1	1	2	1	1	4	1	0	5	0	0	0	0	0	5000	2	5	7	623901	470	
36	Point 204	2101591	200900020	2009420007	02-00-115	2009-07-01	1	7	6	31	0		US 20	33	1	6	16	0	2	1	3	6	2	1	1														

b. Roundabout Data

- Data obtained from SAMUEL.STURTZ@iowadot.us

- 110 roundabouts constructed from 2000 to 2023

ID	Shape *	SymbolID	Intersect	Description	Year Open	Category	Resident	Splitter	1st Refuge	Apron	Lane	Local City	County	Classifica	Year	Construction	Creator	ModifiedDate	Editor	NextRoundabout	Roundabout	4 Resident	4 Splitter	4 1st Refu	4 Apron	
1	Point 2M	0	San Pto Dr & Prairie Pl.	Multi-lane in new con...	2009	Modern Roundabout	0	1	1	1	1.5	3 Albena	Polk	Commercial	2009-01-01	2019-04-05	isswDOT_MayJrCps	2019-06-12	Ryan.Winn@iowadot...	0	Roundabout	No	Yes	Yes	Yes	
2	1	Point 2M	0	Veranda Dr & Veringa...	Replacing alleyway stop	2013	Modern Roundabout	0	1	1	1	2	4 Jackson	Polk	Commercial	2013-01-01	2019-04-05	isswDOT_MayJrCps	2019-06-12	Ryan.Winn@iowadot...	0	Roundabout	No	Yes	Yes	Yes
3	2	Point 2M	0	SW Cherry St & SW 11...	New roadway adjacen...	2011	Modern Roundabout	0	1	1	1	1	4 Jackson	Polk	Commercial	2011-01-01	2019-04-05	isswDOT_MayJrCps	2019-06-12	Ryan.Winn@iowadot...	1	Roundabout	No	Yes	Yes	Yes
4	3	Point 2M	0	SW Singler Blvd & Pra...	New residential devel...	2006	Modern Roundabout	1	1	0	1	1	4 Jackson	Polk	Residential	2006-01-01	2019-04-05	isswDOT_MayJrCps	2019-06-12	Ryan.Winn@iowadot...	0	Roundabout	Yes	Yes	No	Yes
5	4	Point 2M	0	SW 13th Street & NW...	New residential devel...	2005	Modern Roundabout	1	1	0	1	1	4 Jackson	Polk	Residential	2005-01-01	2019-04-05	isswDOT_MayJrCps	2019-06-12	Ryan.Winn@iowadot...	0	Roundabout	Yes	Yes	No	Yes
6	5	Point 2M	0	SW Goodwin St & SW...	One of three in a new...	2004	Modern Roundabout	1	1	0	1	1	4 Jackson	Polk	Residential	2004-01-01	2019-04-05	isswDOT_MayJrCps	2019-06-12	Ryan.Winn@iowadot...	0	Roundabout	Yes	Yes	No	Yes
7	6	Point 2M	0	SW Seminary Blvd & S...	One of three in a new...	2004	Modern Roundabout	1	1	0	1	1	3 Jackson	Polk	Residential	2004-01-01	2019-04-05	isswDOT_MayJrCps	2019-06-12	Ryan.Winn@iowadot...	0	Roundabout	Yes	Yes	No	Yes
8	7	Point 2M	0	SW Seminary Blvd & S...	One of three in a new...	2004	Modern Roundabout	1	1	0	1	1	4 Jackson	Polk	Residential	2004-01-01	2019-04-05	isswDOT_MayJrCps	2019-06-12	Ryan.Winn@iowadot...	0	Roundabout	Yes	Yes	No	Yes
9	8	Point 2M	0	SW Campbush Ct	New Construction etc...	2011	Modern Roundabout	1	1	1	1	1	4 Jackson	Polk	Residential	<N/A>	2019-04-05	isswDOT_MayJrCps	2019-06-12	Ryan.Winn@iowadot...	0	Roundabout	Yes	Yes	Yes	Yes
10	9	Point 2M	0	Madison Road & 13th A...	Designed to accommo...	2002	Modern Roundabout	1	1	1	1	1.5	4 Bettendorf	Scott	Residential	2002-01-01	2019-04-05	isswDOT_MayJrCps	2019-06-12	Ryan.Winn@iowadot...	0	Roundabout	Yes	Yes	Yes	Yes
11	10	Point 2M	0	Independence Ave (S...	First high-speed rural...	2008	Modern Roundabout	0	1	0	1	1	4 Jural	Black Hawk	Rural	2008-01-01	2019-04-05	isswDOT_MayJrCps	2019-06-12	Ryan.Winn@iowadot...	0	Roundabout	No	Yes	No	Yes
12	11	Point 2M	0	I-73 & I-62	Rural, high-speed rural...	2012	Modern Roundabout	0	1	0	1	1	4 rural (south of Parkersb...	Buchanan	Rural	2012-01-01	2019-04-05	isswDOT_MayJrCps	2019-06-12	Ryan.Winn@iowadot...	0	Roundabout	No	Yes	No	Yes
13	12	Point 2M	0	Wilcox Road & Cedar...	One-lane/two-lane hy...	2007	Modern Roundabout	0	1	1	0	1.5	3 Cedar Falls	Black Hawk	Rural	2007-01-01	2019-04-05	isswDOT_MayJrCps	2019-06-12	Ryan.Winn@iowadot...	0	Roundabout	No	Yes	Yes	No
14	13	Point 2M	0	Brandenburg Rd & Cedar...	In new construction etc...	2009	Modern Roundabout	0	1	1	0	2	4 Cedar Falls	Black Hawk	Commercial	2009-01-01	2019-04-05	isswDOT_MayJrCps	2019-06-12	Ryan.Winn@iowadot...	0	Roundabout	No	Yes	Yes	No
15	14	Point 2M	0	Radway Ave & Cedar...	Reassigned north appro...	2011	Modern Roundabout	0	1	1	1	1	4 Cedar Falls	Black Hawk	Commercial	2011-01-01	2019-04-05	isswDOT_MayJrCps	2019-06-12	Ryan.Winn@iowadot...	0	Roundabout	No	Yes	Yes	Yes
16	15	Point 2M	0	10th Ave SW & Towne...	One-lane/two-lane hy...	2011	Modern Roundabout	0	1	1	1	2	4 Cedar Rapids	Linn	Commercial	2011-01-01	2019-04-05	isswDOT_MayJrCps	2019-06-12	Ryan.Winn@iowadot...	0	Roundabout	No	Yes	Yes	Yes
17	16	Point 2M	0	SW 13th Street & S...	Combination dual/lan...	2002	Modern Roundabout	1	1	1	1	2	4 Chow	Dallas	Residential	2002-01-01	2019-04-05	isswDOT_MayJrCps	2019-06-12	Ryan.Winn@iowadot...	0	Roundabout	Yes	Yes	Yes	Yes
18	17	Point 2M	0	Berkshire Parkway & S...	Three public approach...	2001	Other Circular Intersec...	1	1	0	0	1	3 Chow	Dallas	Traffic Circle	2001-01-01	2019-04-05	isswDOT_MayJrCps	2019-06-12	Ryan.Winn@iowadot...	0	Yes	Yes	No	No	
19	18	Point 2M	0	Berkshire Parkway & B...	In new residential dev...	2005	Modern Roundabout	1	1	1	1	1	4 Chow	Dallas	Residential	2005-01-01	2019-04-05	isswDOT_MayJrCps	2019-06-12	Ryan.Winn@iowadot...	0	Roundabout	Yes	Yes	Yes	Yes
20	19	Point 2M	0	University Pkwy & U.S...	New 5-lane intersection	2013	Modern Roundabout	0	1	1	1	1	3 Coralville	Johnson	Commercial	2013-01-01	2019-04-05	isswDOT_MayJrCps	2019-06-12	Ryan.Winn@iowadot...	0	Roundabout	No	Yes	Yes	Yes
21	20	Point 2M	0	Hayward Dr & Rural...	New 5-lane intersection	2013	Modern Roundabout	0	1	1	1	1.5	3 Coralville	Johnson	Commercial	2013-01-01	2019-04-05	isswDOT_MayJrCps	2019-06-12	Ryan.Winn@iowadot...	0	Roundabout	No	Yes	Yes	Yes
22	21	Point 2M	0	Radway Ave & Univer...	New 5-lane intersection	2013	Modern Roundabout	0	1	1	1	1	3 Coralville	Johnson	Commercial	2013-01-01	2019-04-05	isswDOT_MayJrCps	2019-06-12	Ryan.Winn@iowadot...	0	Roundabout	No	Yes	Yes	Yes
23	22	Point 2M	0	1st Ave & Highway Rd	Hybrid dual/triangle in...	2002	Modern Roundabout	1	1	1	1	1.5	3 Coralville	Johnson	Residential	2002-01-01	2019-04-05	isswDOT_MayJrCps	2019-06-12	Ryan.Winn@iowadot...	0	Roundabout	Yes	Yes	Yes	Yes
24	23	Point 2M	0	12th Ave & Farmington...	North approach is mid...	2005	Modern Roundabout	0	1	1	1	1	3 Coralville	Johnson	Commercial	2005-01-01	2019-04-05	isswDOT_MayJrCps	2019-06-12	Ryan.Winn@iowadot...	1	Roundabout	No	Yes	Yes	Yes
25	24	Point 2M	0	10th St & Quarry Road	Double-lane, north ap...	2006	Modern Roundabout	0	1	1	1	2	3 Coralville	Johnson	Commercial	2006-01-01	2019-04-05	isswDOT_MayJrCps	2019-06-12	Ryan.Winn@iowadot...	0	Roundabout	No	Yes	Yes	Yes
26	25	Point 2M	0	Highway Road & Canal...	South approach is c...	2007	Modern Roundabout	0	1	1	1	1	4 Coralville	Johnson	Commercial	2007-01-01	2019-04-05	isswDOT_MayJrCps	2019-06-12	Ryan.Winn@iowadot...	0	Roundabout	No	Yes	Yes	Yes
27	26	Point 2M	0	Commerce Dr & Comm...	Rebuilt 4-lane intersec...	2014	Modern Roundabout	0	1	1	1	1	4 Coralville	Johnson	Commercial	2014-01-01	2019-04-05	isswDOT_MayJrCps	2019-06-12	Ryan.Winn@iowadot...	0	Roundabout	No	Yes	Yes	Yes
28	27	Point 2M	0	SW 28th St & Jefferson...	In the Airport Business...	2000	Modern Roundabout	0	1	1	1	1	4 Des Moines	Polk	Commercial	2000-01-01	2019-04-05	isswDOT_MayJrCps	2019-06-12	Ryan.Winn@iowadot...	0	Roundabout	No	Yes	Yes	Yes
29	28	Point 2M	0	10th St & Iowa 167	Rural, high-speed, ad...	2009	Modern Roundabout	0	1	0	1	1	4 Jural	Pageville	Rural	2009-01-01	2019-04-05	isswDOT_MayJrCps	2019-06-12	Ryan.Winn@iowadot...	1	Roundabout	No	Yes	No	Yes
30	29	Point 2M	0	10th Ave NW & N 13th St	Replaced first "T" inter...	2009	Modern Roundabout	0	1	1	1	1	3 Post Dodge	Webster	Commercial	2009-01-01	2019-04-05	isswDOT_MayJrCps	2019-06-12	Ryan.Winn@iowadot...	1	Roundabout	No	Yes	Yes	Yes
31	30	Point 2M	0	Co Rd C23 & Matthews...	Between 3 urban/loc...	2013	Modern Roundabout	0	1	1	1	1	4 Gilbert	Story	Commercial	2013-01-01	2019-04-05	isswDOT_MayJrCps	2019-06-12	Ryan.Winn@iowadot...	1	Roundabout	No	Yes	Yes	Yes
32	31	Point 2M	0	Grand Ave & S Grand...	Three approach circ...	2007	Modern Roundabout	0	1	1	1	1	3 Iowa City	Johnson	Commercial	2007-01-01	2019-04-05	isswDOT_MayJrCps	2019-06-12	Ryan.Winn@iowadot...	0	Roundabout	No	Yes	Yes	Yes
33	32	Point 2M	0	Kennedy Parkway & M...	In new residential dev...	2006	Modern Roundabout	1	1	1	1	1	4 Iowa City	Johnson	Residential	2006-01-01	2019-04-05	isswDOT_MayJrCps	2019-06-12	Ryan.Winn@iowadot...	0	Roundabout	Yes	Yes	Yes	Yes
34	33	Point 2M	0	US 210 southbound in...	Diamond interchange...	2012	Modern Roundabout	0	1	0	1	1	3 Janesville	Bremer	Rural	2012-01-01	2019-04-05	isswDOT_MayJrCps	2019-06-12	Ryan.Winn@iowadot...	0	Roundabout	No	Yes	No	Yes
35	34	Point 2M	0	US 210 northbound in...	Diamond interchange...	2012	Modern Roundabout	0	1	0	1	1	3 Janesville	Bremer	Rural	2012-01-01	2019-04-05	isswDOT_MayJrCps	2019-06-12	Ryan.Winn@iowadot...	0	Roundabout	No	Yes	No	Yes
36	35	Point 2M	0	SW 42nd Ave & Perna...	1 of 4 on 42nd Ave con...	2012	Modern Roundabout	0	1	1	1	2	3 Johnston	Polk	Commercial	2012-01-01	2019-04-05	isswDOT_MayJrCps	2019-06-12	Ryan.Winn@iowadot...	0	Roundabout	No	Yes	Yes	Yes
37	36	Point 2M	0	SW 42nd Ave & South...	2 of 4 on 42nd Ave con...	2012	Modern Roundabout	0	1	1	1	2	4 Johnston	Polk	Commercial	2012-01-01	2019-04-05	isswDOT_MayJrCps	2019-06-12	Ryan.Winn@iowadot...	0	Roundabout	No	Yes	Yes	Yes
38	37	Point 2M	0	SW 42nd Ave & DuBois...	3 of 4 on 42nd Ave con...	2012	Modern Roundabout	0	1	1	1	2	3 Johnston	Polk	Commercial	2012-01-01	2019-04-05	isswDOT_MayJrCps	2019-06-12	Ryan.Winn@iowadot...	0	Roundabout	No	Yes	Yes	Yes
39	38	Point 2M	0	SW 42nd Ave & Perna...	4 of 4 on 42nd Ave con...	2012	Modern Roundabout	0	1	1	1	2	3 Johnston	Polk	Commercial	2012-01-01	2019-04-05	isswDOT_MayJrCps	2019-06-12	Ryan.Winn@iowadot...	0	Roundabout	No	Yes	Yes	Yes
40	39	Point 2M	0	Tower Terrace & Albu...	New intersection on A...	2013	Modern Roundabout	0	1	1	1	1.5	4 Marion	Linn	Commercial	2013-01-01	2019-04-05	isswDOT_MayJrCps	2019-06-12	Ryan.Winn@iowadot...	0	Roundabout	No	Yes	Yes	Yes
41	40	Point 2M	0	13th St & Tower Terr...	Two-lane and one-lan...	2011	Modern Roundabout	1	1	1	1	1.5	4 Marion	Linn	Residential	2011-01-01	2019-04-05	isswDOT_MayJrCps	2019-06-12	Ryan.Winn@iowadot...	0	Roundabout	Yes	Yes	Yes	Yes
42	41	Point 2M	0	14th St & Mason City H...	Reconfig/round inter...	2013	Modern Roundabout	0	1	1	1	1	3 Mason City	Cerro Gordo	Commercial	2013-01-01	2019-04-05	isswDOT_MayJrCps	2019-06-12	Ryan.Winn@iowadot...	0	Roundabout	No	Yes	Yes	Yes
43	42	Point 2M	0	US 51 & Iowa 1	Replaced 4-way stop	2013	Modern Roundabout	0	1	0	1	1.5	4 Mount Vernon	Linn	Commercial	2013-01-01	2019-04-05	isswDOT_MayJrCps	2019-06-12	Ryan.Winn@iowadot...	0	Roundabout	No	Yes	No	Yes
44	43	Point 2M	0	US 51 & 10th Ave S	Three approaches repl...	2013	Modern Roundabout	0	1	1	1	1	3 Mount Vernon	Linn	Commercial	2013-01-01	2019-04-05	isswDOT_MayJrCps	2019-06-12	Ryan.Winn@iowadot...	0	Roundabout	No	Yes	Yes	Yes
45	44	Point 2M	0	Orchard Ave & Pella R...	Includes pedestrian cr...	2003	Modern Roundabout	0	1	1	1	1	4 Oskaloosa	Maharaja	Commercial	2003-01-01	2019-04-05	isswDOT_MayJrCps	2019-06-12	Ryan.Winn@iowadot...	0	Roundabout	No	Yes	Yes	Yes
46	45	Point 2M	0	1st St SW & US 63	Three approach incl...	2006	Modern Roundabout	0	1	0	1	1	3 Ottumwa	Wapello	Commercial	2006-01-01	2019-04-05	isswDOT_MayJrCps	2019-06-12	Ryan.Winn@iowadot...	0	Roundabout	No	Yes	No	Yes
47	46	Point 2M	0	Pondra St & NECC ent...	Single-lane, near entr...	2012	Modern Roundabout	0	1	1	1	1	4 Pella	Dubuque	Commercial	2012-01-01	2019-04-05	isswDOT_MayJrCps	2019-06-12	Ryan.Winn@iowadot...	0	Roundabout	No	Yes	Yes	Yes
48	47	Point 2M	0	SW 142nd St & Dougla...	Double-lane, south ap...	2017	Modern Roundabout	1	1	1	1	2	4 Urbandale	Polk	Residential	2017-08-01	2019-04-05	isswDOT_MayJrCps	2019-06-12	Ryan.Winn@iowadot...	0	Roundabout	Yes	Yes	Yes	Yes
49	48	Point 2M	0	1st Ave NW & SW 35th St	Replaced "T" intersec...	2005	Modern Roundabout	0	1	1	0	1	4 Waverly	Bremer	Commercial	2005-01-01	2019-04-05	isswDOT_MayJrCps	2019-06-12	Ryan.Winn@iowadot...	0	Roundabout	No	Yes	Yes	No
50	49	Point 2M	0	W Wills Fargo Trail &...	In new Wills Fargo de...	2005	Other Circular Intersec...	0	1	0	1	1	3 West Des Moines	Dallas	Traffic Circle	2005-01-01	2019-04-05	isswDOT_MayJrCps	2019-06-12	Ryan.Winn@iowadot...	0	No	Yes	No	Yes	
51	50	Point 2M	0	W Wills Fargo Trail &...	In new Wills Fargo de...	2005	Other Circular Intersec...	0	1	0	1	1	3 West Des Moines	Dallas	Traffic Circle	2005-01-01	2019-04-05	isswDOT_MayJrCps	2019-06-12	Ryan.Winn@iowadot...	0	No	Yes	No	Yes	
52	51	Point 2M	0	West Access & W Wills...	In new Wills Fargo de...	2006	Other Circular Intersec...	0	1	0	1	1	4 West Des Moines	Dallas	Traffic Circle	2006-01-01	2019-04-05	isswDOT_MayJrCps								

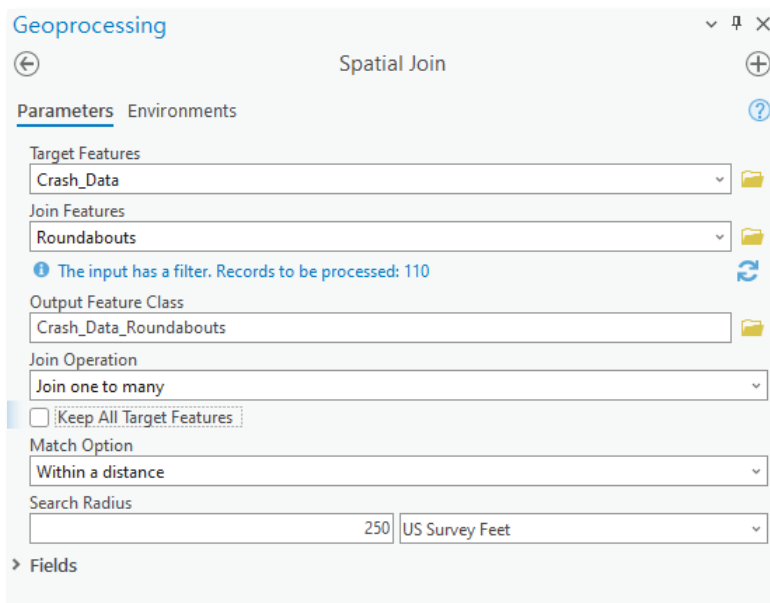
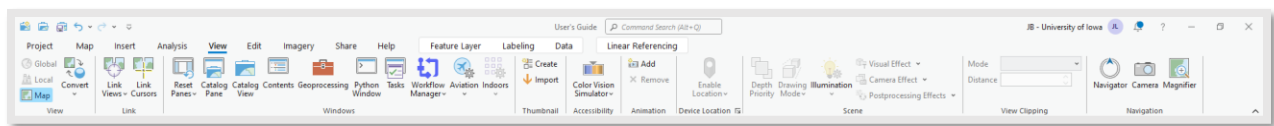
2. Data Preprocessing in ArcGIS Pro

In this phase, we will employ ArcGIS Pro to conduct preliminary processing on two datasets, setting the stage for subsequent in-depth analysis and visualization. This involves refining and consolidating the data to ensure it is optimally structured for our intended uses.

2-1. Performing Spatial Join on Layer Files

By performing a spatial join between the 'Crash_Data' and 'Roundabouts' layers, we can create a merged layer file that displays crash data occurring within a 250-foot radius of each roundabout

- From the ArcGIS Pro Navigation bar, select 'View' > 'Geoprocessing' > 'Spatial Join'.



- Parameters:

- Target Features: Crash_Data
- Joined Features: Roundabouts
- Output Feature Class: Crash_Data_Roundabouts
 - This will be the name for the new layerfile.
- Join Operation: Join one to many
- Uncheck 'Keep All Target Features'

f. Match Option: Within a Distance

g. Search Radius: 250 US Survey Feet

> Click the 'Run' button to perform the spatial join of the two layers.

a. Spatial-Joined Data (Crash_Data_Roundabouts)

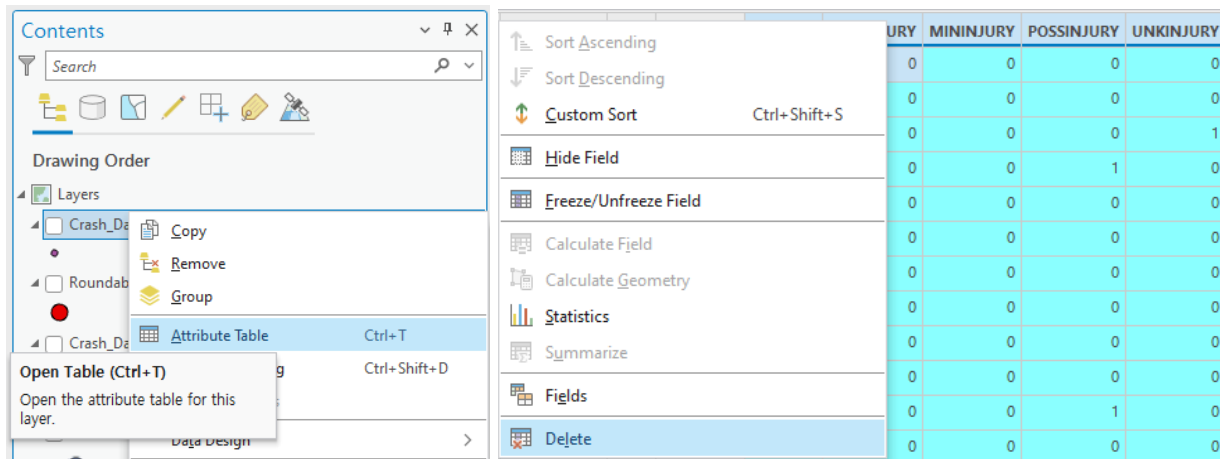
- 110 total roundabouts constructed from 2000 to 2023

- 2,671 total crashes from 2009 to 2023

OBJECTID	Shape*	Join_Count	TARGET_FID	JOIN_FID	OBJECTID	CRASH_KEY	CASENUMBER	LEASENUM	CRASH_DATE	CRASH_MONTH	CRASH_DAY	DISTRICT	COUNTY_NUM	CITY_NUMBER	SYSTEMID	LITERAL	POSTMILE	LOCPOSTMILE	CIRCUMFERENCE	MARKER	DRUGALC	RENTLOC	LIGHT	CRSPEND	WEATHER	RENTLOC	RDTYPE	PAVED	WZBLATED	CSRY	FACILITIES	INJURIES	MAINTAIN		
1	Point 2M	1	152	74	218171	2009020494	2009457044	01-0230	2009-01-18	1	1	1	94	0		1ST AVE S CONNECT...	33	1	3	24	3	1	4	5	2	2	13	1	0	5	0	0	0	0	
2	Point 2M	1	327	95	218182	2009050291	2009490938	01-01-4857	2009-02-02	2	2	6	31	0		UNIVERSITY AVE & CL...	33	1	5	7	8	1	4	1	1	1	12	1	0	5	0	0	0	0	
3	Point 2M	1	454	105	2182010	200907314	2009493235	01-010124	2009-02-14	2	7	1	77	0		NE RISING SUN DR	33	1	5	30	8	2	1	3	1	1	1	1	0	4	0	1	0	0	
4	Point 2M	1	705	97	2182270	2009014843	2009502015	00070401	2009-04-14	4	3	6	57	0		10TH AVE & CENTRAL...	33	1	3	70	8	1	1	1	1	1	1	1	0	4	0	1	0	0	
5	Point 2M	1	800	72	2182365	2009012362	2009499124	01-01-12980	2009-03-23	3	2	6	31	0		GRANDVIEW AVE N	33	1	5	7	8	1	1	1	2	5	1	12	1	0	5	0	0	0	0
6	Point 2M	1	1555	71	2181320	2009023783	2009512757	00864333	2009-06-15	6	2	2	7	0		N FRONTAGE RD & M...	33	1	5	7	8	1	1	1	1	1	13	1	0	5	0	0	0	0	0
7	Point 2M	1	1691	65	2182356	2009028320	2009517465	00015718	2009-07-24	7	6	6	57	0		W 8TH AVE & LINDALE...	54	1	1	20	8	1	4	2	5	2	12	1	0	5	0	0	0	0	0
8	Point 2M	1	1100	31	2183483	2009020436	2009518527	00071813	2009-08-02	8	1	6	52	0		S GRAND AVE & UNIV...	33	1	6	70	8	1	1	1	1	1	1	1	0	5	0	0	0	0	0
9	Point 2M	1	2264	103	2183820	2009037149	2009527210		2009-08-10	9	5	6	57	0		JOHNSON AVE NW	33	6	3	9	8	77	1	1	99	77	4	1	0	5	0	0	0	0	0
10	Point 2M	1	2865	22	2184430	2009045933	2009537877	00861938	2009-11-18	11	4	6	52	0		1ST AVE	33	1	6	8	8	1	1	2	5	1	97	1	0	5	0	0	0	0	0
11	Point 2M	1	3263	99	2184628	2009056786	2009545726	00157468	2009-12-20	12	3	2	7	0	IA 934	IA 934/UNIVERSITY AVE...	33	1	4	2	8	1	4	1	1	1	1	12	1	0	4	0	1	0	0
12	Point 2M	1	3535	82	2185100	2010000942	2010549193	2010000638	2010-01-01	1	6	6	57	0		JACOBIN DR SW & JAC...	33	1	5	7	8	1	1	1	1	2	1	12	1	0	5	0	0	0	0
13	Point 2M	1	3580	95	2185145	2010001586	2010548328	01-10-1520	2010-01-12	1	3	6	31	0		UNIVERSITY AVE & CL...	33	1	5	3	8	1	1	2	2	1	12	1	0	5	0	0	0	0	0
14	Point 2M	1	3889	65	2185454	2010060703	2010555592		2010-01-25	1	2	6	52	0		Co Rd WINDOUBOUQUE	33	1	3	46	8	2	1	4	7	2	1	1	0	4	0	1	0	0	0
15	Point 2M	1	4433	60	2185938	2010071605	2010565894	10070225	2010-02-11	2	5	6	52	0		CADDALE RD & 1ST...	33	1	5	7	8	1	4	1	1	1	12	1	0	5	0	0	0	0	0
16	Point 2M	1	4448	58	2186011	2010071602	2010566938	10070102	2010-04-09	4	6	6	57	0		7TH AVE	33	1	6	30	8	1	1	1	1	1	1	1	0	5	0	0	0	0	0
17	Point 2M	1	4809	76	2186174	2010020010	2010571170	01-10-20502	2010-05-07	5	6	6	31	0		UNIVERSITY AVE	33	1	6	16	8	2	1	2	5	1	14	1	0	5	0	0	0	0	0
18	Point 2M	1	4892	99	2186448	2010020070	2010574070	10094688	2010-05-27	5	5	2	7	0	IA 934	IA 934/UNIVERSITY AVE...	33	1	4	9	8	1	1	1	1	1	1	12	1	0	5	0	0	0	0
19	Point 2M	1	5287	53	2186552	2010020070	2010576180	10074002	2010-07-16	7	6	6	57	0		35TH ST	33	1	5	7	8	1	1	1	1	1	1	12	1	0	5	0	0	0	0
20	Point 2M	1	5485	14	2187050	2010032716	2010585596	10082701	2010-08-07	8	7	2	7	0		W RIDGEWAY AVE	95	1	1	70	8	1	1	1	1	1	13	1	0	1	1	1	0	0	0
21	Point 2M	1	5580	47	2187125	2010033736	2010587072	10-20-270	2010-08-23	8	2	1	77	0		142ND ST	33	1	6	71	8	1	1	1	1	1	97	1	0	5	0	0	0	0	0
22	Point 2M	1	5637	42	2187402	2010045952	2010594717	201010650	2010-10-09	10	7	6	57	0	US 50	US 50 & IA 15 1ST AVE	33	1	5	7	8	1	1	1	1	1	12	1	0	3	0	1	0	0	0
23	Point 2M	1	5980	94	2187533	2010041937	2010596191	10112380	2010-10-23	10	7	2	7	0	IA 934	IA 934/UNIVERSITY AVE	33	1	3	24	8	1	1	1	1	1	1	1	0	5	0	0	0	0	0
24	Point 2M	1	5974	76	2189359	2010040431	2010594537	01-10-40652	2010-10-08	10	6	6	31	0		UNIVERSITY AVE	33	1	5	10	8	1	1	1	1	1	4	1	0	5	0	0	0	0	0
25	Point 2M	1	6188	76	2187391	2010046212	2010600884	01-10-68189	2010-11-15	11	2	6	31	0		ASBURY RD	33	1	5	10	8	1	1	1	1	1	4	1	0	4	0	1	0	0	0
26	Point 2M	1	6302	31	2187387	2010045950	2010600563	2010-12-017	2010-11-01	11	2	6	52	0		GRAND AVE	33	1	3	24	8	1	1	1	1	1	97	1	0	5	0	0	0	0	0
27	Point 2M	1	6354	50	2218410	2009020317	2009443101	00003481	2009-01-20	1	3	6	52	0		HOLDEN RD & 12TH AVE	33	1	6	45	8	1	1	3	2	2	1	1	0	5	0	0	0	0	0
28	Point 2M	1	6355	54	2218411	2009020316	2009443101	00003521	2009-01-20	1	3	6	57	0		7TH AVE	33	1	3	70	8	1	2	2	1	1	1	1	0	5	0	0	0	0	0
29	Point 2M	1	7004	54	2218480	2009000088	20094474	00000671	2009-01-11	1	1	6	57	0		7TH AVE & 7TH ST	33	1	5	2	8	1	1	4	2	1	12	1	0	5	0	0	0	0	0
30	Point 2M	1	9120	33	2228598	2009037105	2009527269	2009054851	2009-05-18	9	6	2	9	0	US 218	US 218 & BARROCK RD	33	1	5	7	8	1	1	1	1	1	12	1	0	2	0	2	0	0	0
31	Point 2M	1	9140	75	2228619	2009035052	2009534074	01-03-40206	2009-05-13	9	1	6	31	0		UNIVERSITY AVE	33	1	3	24	8	1	2	1	1	1	1	1	0	5	0	0	0	0	0
32	Point 2M	1	9195	72	2228671	2009037420	2009527616	01-03-48773	2009-05-28	9	2	6	31	0		GRACE ST & DEWIS ST...	33	1	5	7	8	1	1	1	1	1	15	1	0	4	0	3	0	0	0
33	Point 2M	1	10185	76	2227661	2009035701	2009544096	01-03-80704	2009-12-27	12	1	6	31	0		UNIVERSITY AVE	33	1	1	20	8	2	4	4	7	2	14	1	0	5	0	0	0	0	0
34	Point 2M	1	11154	30	2228260	2010013483	2010564582	10-3854	2010-03-22	3	2	1	85	0		MATHEWS ST	33	1	3	16	8	5	1	1	1	1	12	1	0	5	0	0	0	0	0
35	Point 2M	1	11953	99	2232429	2010026587	2010579500	10086809	2010-06-28	6	2	2	7	0	IA 934	IA 934/UNIVERSITY AVE...	33	1	3	70	8	1	1	1	1	1	12	1	0	5	0	0	0	0	0
36	Point 2M	1	11973	98	2232440	2010027377	2010579622	20100007127	2010-07-04	7	1	1	77	0		BEAVER AVE	33	1	3	45	8	1	1	2	5	1	1	1	0	4	0	1	0	0	0
37	Point 2M	1	12400	45	2232676	2010033332	2010586617	20100054792	2010-08-10	8	3	5	90	0	US 54	US 54	33	1	3	20	7	1	1	1	99	1	13	1	0	3	0	2	0	0	
38	Point 2M	1	12485	99	2232961	2010025987	2010580485	10005488	2010-09-03	9	4	2	7	0	IA 934	IA 934/UNIVERSITY AVE...	33	1	3	24	8	1	1	1	1	1	1	12	1	0	4	0	1	0	0
39	Point 2M	1	13403	65	2234079	2010040375	2010603741	10004940	2010-12-03	12	6	6	57	0		LINDALE DR	33	1	3	70	8														

"In the 'Crash_Data_Roundabouts' dataset, we'll focus on retaining only the essential columns for our analysis. These include: 'OBJECTID', 'Shape', 'XCOORD', 'YCOORD', 'JOIN_FID', 'CRASH_DATE', 'CSEV', 'FATALITIES', 'PROPDMG', 'Year_Open', 'Category', 'City', and 'County'. The 'Shape', 'XCOORD', and 'YCOORD' columns provide spatial information (coordinates). 'Year_Open' indicates the construction year of the roundabouts, 'JOIN_FID' is the unique identifier for each roundabout, 'CSEV' represents crash severity, and 'PROPDMG' details the property damage."

To manually remove unnecessary columns, right-click on 'Crash_Data_Roundabouts' in the Contents pane, select 'Attribute Table', then right-click on the columns you wish to remove and choose 'Delete'.



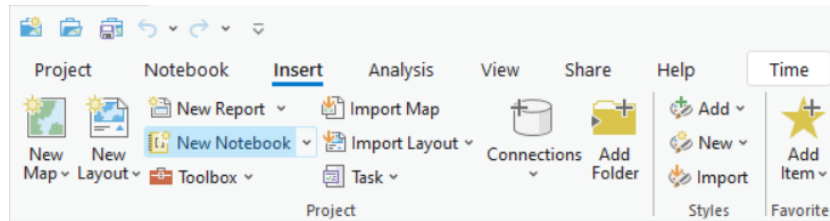
a. Streamlined 'Crash_Data_Roundabouts'

OBJECTID_1 *	Shape *	JOIN_FID	CRASH_DATE	CSEV	FATALITIES	PROPDMG	XCOORD	YCOORD	Year_Open	Category	City	County	Classifica
1	Point ZM	74	1/18/2009	5	0	3000	402829	4706531	2016	Modern Roundabout	Fort Dodge	Webster	Commercial
2	Point ZM	95	2/2/2009	5	0	1200	689968	4707698	2020	Modern Roundabout	Dubuque	Dubuque	Commercial
3	Point ZM	105	2/14/2009	4	0	4000	461011	4604945	2018	Modern Roundabout	Pleasant Hill	Polk	Commercial
4	Point ZM	97	4/14/2009	4	0	1800	615937	4654753		Planned Roundabout	Marion	Linn	Mini Roundabout
5	Point ZM	72	3/23/2009	5	0	2500	689989	4707556	2016	Modern Roundabout	Dubuque	Dubuque	Commercial
6	Point ZM	71	6/15/2009	5	0	1800	546552	4706933	2016	Modern Roundabout	Cedar Falls	Black Hawk	Commercial
7	Point ZM	68	7/24/2009	5	0	2000	614235	4654548	2019	Planned Roundabout	Marion	Linn	Residential
8	Point ZM	31	8/2/2009	5	0	1750	621097	4612888	2007	Modern Roundabout	Iowa City	Johnson	Commercial
9	Point ZM	103	9/10/2009	5	0	2745	605616	4647395	2019	Modern Roundabout	Cedar Rapids	Linn	Commercial
10	Point ZM	22	11/18/2009	5	0	1600	619274	4616659	2002	Modern Roundabout	Coralville	Johnson	Residential
11	Point ZM	99	12/29/2009	4	0	10000	548373	4706208	2017	Modern Roundabout	Cedar Falls	Black Hawk	Commercial
12	Point ZM	92	1/1/2010	5	0	2500	605080	4647106	2019	Modern Roundabout	Cedar Rapids	Linn	Commercial
13	Point ZM	95	1/12/2010	5	0	3100	689968	4707698	2020	Modern Roundabout	Dubuque	Dubuque	Commercial
14	Point ZM	65	1/25/2010	4	0	11500	619719	4619943	2022	Planned Roundabout	Coralville	Johnson	Residential
15	Point ZM	60	2/11/2010	5	0	3100	619590	4617624	2020	Planned Roundabout	Coralville	Johnson	Residential
16	Point ZM	56	4/9/2010	5	0	3000	617291	4654440	2016	Modern Roundabout	Marion	Linn	Commercial
17	Point ZM	76	5/7/2010	5	0	1600	689302	4707827	2020	Planned Roundabout	Dubuque	Dubuque	Commercial
18	Point ZM	99	5/27/2010	5	0	2500	548373	4706208	2017	Modern Roundabout	Cedar Falls	Black Hawk	Commercial
19	Point ZM	58	7/16/2010	5	0	5000	617966	4656349	2016	Modern Roundabout	Marion	Linn	Residential
20	Point ZM	14	8/7/2010	1	1	0	544838	4702053	2011	Modern Roundabout	Cedar Falls	Black Hawk	Commercial
21	Point ZM	47	8/23/2010	5	0	5500	432611	4608886	2017	Modern Roundabout	Urbandale	Polk	Residential
22	Point ZM	42	10/9/2010	3	0	3000	630774	4641663	2013	Modern Roundabout	Mount Vernon	Linn	Commercial
23	Point ZM	94	10/23/2010	5	0	3000	547100	4706888		Modern Roundabout	Cedar Falls	Black Hawk	Residential
24	Point ZM	76	10/8/2010	5	0	2500	689284	4707830	2020	Planned Roundabout	Dubuque	Dubuque	Commercial
25	Point ZM	76	11/15/2010	4	0	3000	689272	4707878	2020	Planned Roundabout	Dubuque	Dubuque	Commercial
26	Point ZM	31	11/1/2010	5	0	3300	621105	4612885	2007	Modern Roundabout	Iowa City	Johnson	Commercial
27	Point ZM	59	1/20/2009	5	0	4200	617924	4616873	2015	Modern Roundabout	Coralville	Johnson	Residential
28	Point ZM	54	1/20/2009	5	0	11000	615702	4654421	2016	Modern Roundabout	Marion	Linn	Commercial
29	Point ZM	54	1/11/2009	5	0	10000	615655	4654420	2016	Modern Roundabout	Marion	Linn	Commercial

3. Advanced Data Preprocessing with Python in ArcGIS Pro

Python in ArcGIS Pro offers powerful scripting capabilities for spatial analysis and automating geoprocessing tasks. Jupyter Notebooks, integrated within ArcGIS Pro, provide an interactive environment where you can write and execute Python code, visualize data, and document the process in a single, easy-to-use interface.

To open a new Notebook in ArcGIS Pro, go to the Navigation bar, click on ‘Insert’, and then select ‘New Notebook’.



3-1. Loading 'Crash_Data_Roundabouts' Layer into a Pandas DataFrame in Jupyter Notebook

The code snippet below will access the "Crash_Data_Roundabouts" layer from an ArcGIS Pro project and converts it into a pandas DataFrame. It will retrieve all data and field names from the layer, allowing for efficient data manipulation and analysis within a Jupyter Notebook environment.

```
import arcpy
import pandas as pd
# Access the current ArcGIS Pro project
project = arcpy.mp.ArcGISProject("CURRENT")
arcmmap = project.listMaps("Layers")[0]
# Access the "Crash_Data_Roundabouts" layer
layer = [lyr for lyr in arcmmap.listLayers() if lyr.name == "Crash_Data_Roundabouts"][0]
# Use SearchCursor to extract data from the layer
data = [row for row in arcpy.da.SearchCursor(layer, "*")]
# Get the field names
field_names = [field.name for field in arcpy.ListFields(layer)]
# Create a pandas DataFrame from the data
original_data = pd.DataFrame(data, columns=field_names)
# Display DataFrame 'original_data'
original_data.head()
```

	OBJECTID_1	Shape	JOIN_FID	CRASH_DATE	CSEV	FATALITIES	PROPDGM	XCOORD	YCOORD	Year_Open	Category	City	County	Classifica
0	1	(-94.18270383781186, 42.505045555208255)	74	2009-01-18	5	0	3000	402829	4706531	2016	Modern Roundabout	Fort Dodge	Webster	Commercial
1	2	(-90.68811838405617, 42.498333890496724)	95	2009-02-02	5	0	1200	689968	4707698	2020	Modern Roundabout	Dubuque	Dubuque	Commercial
2	3	(-93.46782795179848, 41.59525399037943)	105	2009-02-14	4	0	4000	461011	4604945	2018	Modern Roundabout	Pleasant Hill	Polk	Commercial
3	4	(-91.5993114487643, 42.03627658719478)	97	2009-04-14	4	0	1800	615937	4654753		Planned Roundabout	Marion	Linn	Mini Roundabout
4	5	(-90.68791011905671, 42.4970509437461)	72	2009-03-23	5	0	2500	689989	4707556	2016	Modern Roundabout	Dubuque	Dubuque	Commercial

3-2. Converted CRASH_DATE to YEAR (From YYYY-MM-DD to YYYY)

```
original_data['CRASH_YEAR'] = pd.to_datetime(original_data['CRASH_DATE']).dt.year
# Display the DataFrame to verify the new 'YEAR' column
original_data
```


3-3. Reversing Severity Scale in 'CSEV'

The original 'Severity' column ranges from 1 to 5, with 5 indicates crashes involving unknown injuries and 1 indicates the most severe incidents, potentially involving fatalities. For enhanced clarity in our visualization, we will reverse this order in the 'CSEV' column. After this adjustment, a severity rating of 1 will indicate unknown injuries, while a rating of 5 will represent the most severe cases with potential fatalities.

```
# Remap 'CSEV' column values
original_data['CSEV'] = 6 - original_data['CSEV']
# Display the DataFrame to verify the changes
original_data
```

3-4. Adding 'Standard' Column

To analyze the impact of roundabouts on crash occurrences, we will introduce a new column, 'standard', with three categories: 'Before', 'After', and 'Same'. This categorization is based on comparing 'CRASH_DATE' with 'Year_Open'. If the 'CRASH_DATE' occurs before 'Year_Open', the category is set to 'Before'. If it occurs after, it's classified as 'After'. When both dates are the same, the category is marked as 'Same'.

```
# Replace non-numeric values in 'Year_Open' with NaN, then convert to integer
original_data['Year_Open'] = pd.to_numeric(original_data['Year_Open'], errors='coerce').fillna(0).astype(int)
# Remove rows where 'Year_Open' is 0
original_data = original_data[original_data['Year_Open'] != 0]
# Function to determine the standard category
def categorize(row):
    if row['CRASH_DATE'] < row['Year_Open']:
        return 'Before'
    elif row['CRASH_DATE'] > row['Year_Open']:
        return 'After'
    else:
        return 'Same'
# Apply the function to create the 'standard' column
original_data['standard'] = original_data.apply(categorize, axis=1)
# Display the DataFrame to verify the changes
original_data.head()
```

OBJECTID_1	Shape	JOIN_FID	CRASH_DATE	CSEV	FATALITIES	PROPDGM	XCOORD	YCOORD	Year_Open	Category	City	County	Classifica	standard	
0	1	(-94.18270383781186, 42.505045555208255)	74	2009	1	0	3000	402829	4706531	2016	Modern Roundabout	Fort Dodge	Webster	Commercial	Before
1	2	(-90.68811838405617, 42.498333890496724)	95	2009	1	0	1200	689968	4707698	2020	Modern Roundabout	Dubuque	Dubuque	Commercial	Before
2	3	(-93.46782795179848, 41.59525399037943)	105	2009	2	0	4000	461011	4604945	2018	Modern Roundabout	Pleasant Hill	Polk	Commercial	Before
4	5	(-90.68791011905671, 42.4970509437461)	72	2009	1	0	2500	689989	4707556	2016	Modern Roundabout	Dubuque	Dubuque	Commercial	Before
5	6	(-92.43332062784464, 42.51336786973144)	71	2009	1	0	1800	546552	4706933	2016	Modern Roundabout	Cedar Falls	Black Hawk	Commercial	Before

3-5 Excluding Roundabouts with Insufficient Crash Data History

To ensure a comprehensive comparison, we will remove roundabouts constructed between 2000 and 2011, as well as those constructed in 2021, 2022, and 2023. This is because our crash data spans from 2009 to 2023, and we aim to have at least three years of crash data (2009, 2010, 2011) for each roundabout for a robust analysis.

```
# Make a copy of 'original_data'
df_total = original_data.copy()
# Get sorted list of unique 'Year_Open' values
sorted_unique_years = sorted(df_total['Year_Open'].unique())
# Identify the first two and last two 'Year_Open' values
first_ten_years = sorted_unique_years[:10]
last_two_years = sorted_unique_years[-2:]
# Combine the years to be removed
years_to_remove = first_ten_years + last_two_years
# Unique Year List
unique_years = [x for x in sorted_unique_years if x not in years_to_remove]
# Drop rows where 'Year_Open' is in years_to_remove
df_total = df_total[~df_total['Year_Open'].isin(years_to_remove)]
df_total.head()
```

	OBJECTID_1	Shape	JOIN_FID	CRASH_DATE	CSEV	FATALITIES	PROPDGM	XCOORD	YCOORD	Year_Open	Category	City	Co
0	1	(-94.18270383781186, 42.505045555208255)	74	2009	1	0	3000	402829	4706531	2016	Modern Roundabout	Fort Dodge	We
2	3	(-93.46782795179848, 41.59525399037943)	105	2009	2	0	4000	461011	4604945	2018	Modern Roundabout	Pleasant Hill	
4	5	(-90.68791011905671, 42.4970509437461)	72	2009	1	0	2500	689989	4707556	2016	Modern Roundabout	Dubuque	Dub
5	6	(-92.43332062784464, 42.51336786973144)	71	2009	1	0	1800	546552	4706933	2016	Modern Roundabout	Cedar Falls	E
6	7	(-91.61990822948115, 42.03467983550604)	68	2009	1	0	2000	614235	4654548	2019	Planned Roundabout	Marion	

3-6. Analyzing Crash Data Relative to Roundabout Construction Years

To analyze the impact of roundabout construction on road safety, we group crash data by each roundabout's identifier ('JOIN_FID') and the crash dates. We pivot this data to align each roundabout's crash history with its construction year. Then, we calculate the average number of crashes before and after each roundabout was built. The resulting DataFrame, 'crash_count', clearly shows how crash frequencies change relative to the construction dates of roundabouts. For further analysis, key columns like 'FID', 'Year_Open', 'Avg_Before', and 'Avg_After' are saved in a new DataFrame named "Crash".

```
crash_count = df_total.groupby(['JOIN_FID', 'CRASH_DATE']).size().reset_index(name='count')
crash_count = crash_count.pivot(index='JOIN_FID', columns='CRASH_DATE', values='count').fillna(0)
crash_count['Total'] = crash_count.sum(axis=1)
crash_count = crash_count[crash_count['Total'] >= 12]
# Create the mapping of JOIN_FID to Year_Open
year_open = df_total.groupby('JOIN_FID')['Year_Open'].first()
# Join this mapping with the crash_count DataFrame
crash_count = crash_count.join(year_open, on='JOIN_FID')
# Reorder columns to put Year_Open at the beginning
crash_count = crash_count[['Year_Open'] + [col for col in crash_count.columns if col != 'Year_Open']]
# Calculate Avg_Before, Avg_After
for index, row in crash_count.iterrows():
    year_open = row['Year_Open']
    years_before = [col for col in crash_count.columns[1:] if isinstance(col, int) and col < year_open]
    years_after = [col for col in crash_count.columns[1:] if isinstance(col, int) and col > year_open]
    avg_before = row[years_before].sum() / len(years_before) if years_before else 0
    avg_after = row[years_after].sum() / len(years_after) if years_after else 0
    crash_count.at[index, 'Avg_Before'] = avg_before
    crash_count.at[index, 'Avg_After'] = avg_after
# Convert all columns to integers except 'Avg_Before' and 'Avg_After'
int_columns = [col for col in crash_count.columns if col not in ['Avg_Before', 'Avg_After', 'Year_Open']]
crash_count[int_columns] = crash_count[int_columns].fillna(0).astype(int)
# Round 'Avg_Before' and 'Avg_After' to four decimal places
crash_count['Avg_Before'] = crash_count['Avg_Before'].round(4)
crash_count['Avg_After'] = crash_count['Avg_After'].round(4)
# Calculate and append the average of averages
avg_of_avgs = pd.DataFrame({'Avg_Before': [crash_count['Avg_Before'].mean()],
                           'Avg_After': [crash_count['Avg_After'].mean()]},
                           index=['Average'])
crash_count = pd.concat([crash_count, avg_of_avgs])
# Reset index and rename columns
crash_count = crash_count.reset_index()
crash_count = crash_count.rename(columns={'index': 'FID'})
# Display the updated DataFrame
crash_count
```

	FID	Year_Open	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Total	Avg_Before	Avg_After
0	1	2013.0	0.0	0.0	0.0	1.0	4.0	2.0	3.0	1.0	4.0	5.0	4.0	2.0	9.0	12.0	10.0	57.0	0.250000	5.200000
1	26	2014.0	0.0	0.0	0.0	1.0	1.0	2.0	1.0	1.0	0.0	1.0	0.0	0.0	3.0	0.0	2.0	12.0	0.400000	0.888900
2	30	2013.0	0.0	1.0	0.0	0.0	3.0	0.0	3.0	0.0	2.0	1.0	1.0	2.0	1.0	0.0	0.0	14.0	0.250000	1.000000
3	33	2012.0	9.0	3.0	3.0	2.0	1.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.0	5.000000	0.363600
4	35	2012.0	1.0	0.0	0.0	0.0	3.0	1.0	0.0	1.0	0.0	2.0	1.0	2.0	0.0	4.0	0.0	15.0	0.333300	1.272700
5	36	2012.0	1.0	0.0	2.0	1.0	0.0	4.0	1.0	1.0	0.0	0.0	0.0	1.0	0.0	1.0	0.0	12.0	1.000000	0.727300
6	38	2012.0	0.0	1.0	2.0	1.0	4.0	3.0	2.0	0.0	0.0	4.0	3.0	0.0	1.0	2.0	1.0	24.0	1.000000	1.818200
7	42	2013.0	3.0	7.0	6.0	7.0	9.0	13.0	18.0	17.0	22.0	19.0	19.0	9.0	15.0	6.0	2.0	172.0	5.750000	14.000000
8	43	2013.0	3.0	2.0	3.0	1.0	2.0	1.0	3.0	1.0	4.0	3.0	4.0	0.0	0.0	0.0	0.0	27.0	2.250000	1.600000
9	47	2017.0	1.0	5.0	0.0	3.0	5.0	4.0	6.0	3.0	4.0	2.0	7.0	10.0	5.0	13.0	14.0	82.0	3.375000	8.500000
10	53	2017.0	2.0	0.0	0.0	0.0	3.0	1.0	4.0	2.0	4.0	1.0	3.0	1.0	3.0	2.0	2.0	28.0	1.500000	2.000000
11	54	2016.0	12.0	3.0	5.0	3.0	2.0	6.0	8.0	7.0	7.0	9.0	12.0	11.0	5.0	10.0	9.0	109.0	5.571400	9.000000
12	56	2016.0	0.0	2.0	1.0	1.0	1.0	0.0	1.0	1.0	1.0	1.0	0.0	2.0	3.0	4.0	5.0	23.0	0.857100	2.285700
13	57	2014.0	3.0	1.0	2.0	2.0	3.0	0.0	2.0	0.0	2.0	2.0	0.0	2.0	0.0	1.0	0.0	20.0	2.200000	1.000000
14	58	2016.0	0.0	5.0	5.0	3.0	5.0	7.0	4.0	8.0	5.0	5.0	3.0	5.0	5.0	2.0	6.0	68.0	4.142900	4.428600
15	59	2015.0	8.0	2.0	3.0	1.0	1.0	3.0	0.0	5.0	4.0	3.0	1.0	4.0	4.0	7.0	2.0	48.0	3.000000	3.750000
16	68	2019.0	2.0	3.0	2.0	0.0	2.0	2.0	5.0	3.0	1.0	1.0	2.0	2.0	1.0	3.0	1.0	30.0	2.100000	1.750000
17	69	2016.0	0.0	0.0	1.0	1.0	2.0	0.0	0.0	1.0	0.0	3.0	3.0	2.0	4.0	2.0	3.0	22.0	0.571400	2.428600
18	70	2016.0	0.0	0.0	0.0	1.0	2.0	2.0	0.0	0.0	11.0	22.0	8.0	12.0	14.0	16.0	18.0	106.0	0.714300	14.428600
19	71	2016.0	4.0	6.0	4.0	4.0	2.0	7.0	4.0	6.0	1.0	3.0	2.0	3.0	5.0	2.0	2.0	55.0	4.428600	2.571400
20	72	2016.0	6.0	4.0	3.0	2.0	6.0	6.0	4.0	4.0	8.0	7.0	5.0	4.0	2.0	4.0	5.0	70.0	4.428600	5.000000
21	73	2015.0	0.0	1.0	1.0	2.0	0.0	1.0	1.0	0.0	1.0	2.0	1.0	0.0	2.0	0.0	0.0	12.0	0.833300	0.750000
22	74	2016.0	2.0	2.0	2.0	2.0	4.0	3.0	3.0	3.0	3.0	2.0	5.0	2.0	6.0	2.0	3.0	44.0	2.571400	3.285700
23	81	2017.0	1.0	0.0	0.0	2.0	1.0	4.0	3.0	0.0	6.0	3.0	0.0	9.0	6.0	7.0	7.0	49.0	1.375000	5.333300
24	82	2017.0	0.0	0.0	1.0	2.0	1.0	0.0	1.0	1.0	2.0	1.0	0.0	0.0	2.0	1.0	0.0	12.0	0.750000	0.666700
25	83	2016.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	5.0	1.0	0.0	3.0	0.0	2.0	13.0	0.000000	1.857100
26	87	2019.0	2.0	3.0	3.0	3.0	2.0	2.0	8.0	1.0	1.0	0.0	1.0	1.0	2.0	1.0	0.0	30.0	2.500000	1.000000
27	88	2018.0	0.0	3.0	3.0	3.0	5.0	5.0	3.0	7.0	1.0	0.0	2.0	3.0	6.0	2.0	3.0	48.0	3.333300	3.200000
28	89	2019.0	2.0	0.0	1.0	2.0	3.0	2.0	2.0	1.0	2.0	1.0	1.0	2.0	1.0	2.0	2.0	24.0	1.600000	1.750000
29	90	2012.0	0.0	1.0	0.0	0.0	1.0	1.0	2.0	6.0	2.0	2.0	3.0	3.0	6.0	7.0	2.0	36.0	0.333300	3.181800
30	91	2019.0	1.0	0.0	2.0	4.0	1.0	3.0	1.0	3.0	3.0	2.0	1.0	2.0	2.0	2.0	0.0	27.0	2.000000	1.500000
31	92	2019.0	0.0	7.0	8.0	3.0	3.0	6.0	2.0	8.0	3.0	4.0	4.0	1.0	1.0	2.0	1.0	53.0	4.400000	1.250000
32	93	2017.0	1.0	2.0	3.0	3.0	2.0	2.0	1.0	2.0	3.0	3.0	2.0	1.0	2.0	2.0	2.0	31.0	2.000000	2.000000
33	99	2017.0	8.0	10.0	5.0	5.0	7.0	6.0	7.0	5.0	8.0	6.0	2.0	3.0	7.0	6.0	6.0	91.0	6.625000	5.000000
34	103	2019.0	9.0	5.0	7.0	6.0	4.0	6.0	3.0	6.0	2.0	4.0	1.0	3.0	7.0	2.0	2.0	67.0	5.200000	3.500000
35	104	2019.0	0.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0	0.0	0.0	3.0	1.0	0.0	3.0	1.0	13.0	0.500000	1.250000
36	Average	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	2.309553	3.320506

3-7. Creating Roundabout Crash Data Bar Charts with Matplotlib

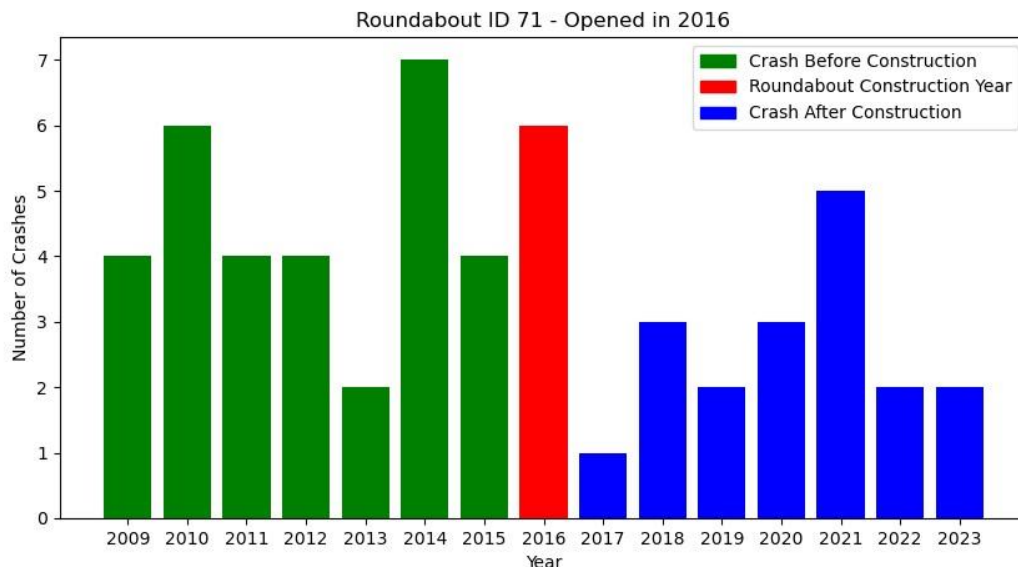
To plot a bar chart for each roundabout's crash data, we will utilize Matplotlib, a powerful plotting library in Python. The code will prompt the user to specify a directory where the charts should be saved. It will then create a new folder in that directory to store the individual bar charts.

For each roundabout, identified by 'FID', we will generate a bar chart showing the number of crashes per year. These charts will be color-coded: years before the roundabout's

construction will be marked in green, the construction year in red, and years after construction in blue. This color scheme will help in visually distinguishing the data points relative to the roundabout's construction year.

After creating each chart, we will add a legend to clarify the color coding and then save the chart as a PNG file in the designated folder. The code will loop through all the roundabouts in the 'crash_count' DataFrame, ensuring each one has a corresponding bar chart, which will be stored in the newly created folder. This systematic approach allows for an efficient and organized way to analyze and visualize the crash data in relation to the construction years of roundabouts.

```
import os
import matplotlib.pyplot as plt
import matplotlib.patches as mpatches
# Ask the user for a directory to save the charts
save_path = input("Enter the directory path where you want to save the charts: ")
# Create a new folder in the specified directory
folder_name = "Roundabout_Crash_Data_Charts"
full_path = os.path.join(save_path, folder_name)
os.makedirs(full_path, exist_ok=True)
# Iterate through each row in the DataFrame
for index, row in crash_count.iterrows():
    year_open = int(row['Year_Open'])
    roundabout_id = row['FID']
    # Prepare data for the bar chart
    years = [year for year in range(2009, 2024)] # Adjust the range as per your data
    values = [row[year] for year in years]
    colors = ['green' if year < year_open else 'red' if year == year_open else 'blue' for year in years]
    # Create the bar chart
    plt.figure(figsize=(10, 5))
    plt.bar(years, values, color=colors)
    plt.title(f'Roundabout ID {roundabout_id} - Opened in {year_open}')
    plt.xlabel('Year')
    plt.ylabel('Number of Crashes')
    plt.xticks(years)
    # Create custom legends
    green_patch = mpatches.Patch(color='green', label='Crash Before Construction')
    red_patch = mpatches.Patch(color='red', label=f'Roundabout Construction Year')
    blue_patch = mpatches.Patch(color='blue', label='Crash After Construction')
    plt.legend(handles=[green_patch, red_patch, blue_patch])
    # Save the plot
    file_name = f'{roundabout_id}.png'
    plt.savefig(os.path.join(full_path, file_name))
    plt.close()
print(f"All charts saved in {full_path}")
```



3-8 Uploading Roundabout Crash Data Charts to AWS S3 Bucket

To display bar charts on an interactive online map, we need to save the PNG files to a server and include their URLs in the "Crash" DataFrame we created earlier. We will use Amazon Web Services (AWS) S3 bucket for hosting these files. Alternatively, if you have a different server or cloud service, you can upload the charts there and use those URLs instead. Here is how to proceed with this task:

i. Set Up AWS Account and S3 Bucket:

First, you need to have an AWS account. If you don't have one, you can create it at AWS Management Console.

Once logged in, navigate to the S3 service and create a new bucket. While creating it, you can set the bucket's privacy settings. Make sure to comply with AWS's best practices for security and privacy.

ii. Upload Files to the S3 Bucket:

Once your bucket is set up, you can upload your files. Navigate to the 'Roundabout_Crash_Data_Charts' folder we created and proceed to upload your files there.

iii. Set Access Control List (ACL) for Public Access:

To make an individual file publicly accessible, you need to change its ACL (Access Control List).

In the S3 console, select the file, then choose the 'Permissions' tab. Under the 'Access control list (ACL)' section, you can set the file to be publicly readable.

Be cautious with public access as it allows anyone on the internet to view or download the file.

Roundabout_Crash_Data_Charts/

Objects | Properties

Objects (34) Info

Objects are the fundamental entities stored in Amazon S3. You can use [Amazon S3 Inventory](#) to get a list of all objects in your bucket. For others to access your objects, you'll need to explicitly grant them permissions. [Learn more](#)

Copy S3 URI Copy URL Download Open Delete Actions Create folder Upload

Find objects by prefix

Name	Type	Last modified	Size	Storage class
1.png	png	December 26, 2023, 10:45:52 (UTC-06:00)	28.5 KB	Standard
103.png	png	December 26, 2023, 10:45:53 (UTC-06:00)	27.6 KB	Standard
104.png	png	December 26, 2023, 10:45:53 (UTC-06:00)	29.7 KB	Standard
30.png	png	December 26, 2023, 10:45:53 (UTC-06:00)	29.9 KB	Standard
33.png	png	December 26, 2023, 10:45:53 (UTC-06:00)	27.5 KB	Standard
35.png	png	December 26, 2023, 10:45:53 (UTC-06:00)	30.6 KB	Standard
36.png	png	December 26, 2023, 10:45:52 (UTC-06:00)	30.6 KB	Standard
38.png	png	December 26, 2023, 10:45:53 (UTC-06:00)	31.0 KB	Standard
42.png	png	December 26, 2023, 10:45:53 (UTC-06:00)	28.3 KB	Standard
43.png	png	December 26, 2023, 10:45:54 (UTC-06:00)	30.3 KB	Standard
47.png	png	December 26, 2023, 10:45:54 (UTC-06:00)	28.6 KB	Standard

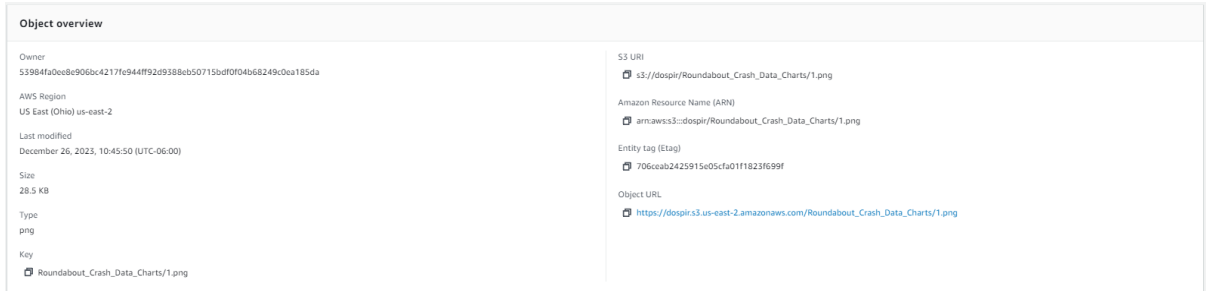
Actions menu:

- Download as
- Share with a presigned URL
- Calculate total size
- Copy
- Move
- Initiate restore
- Query with S3 Select
- Edit actions
 - Rename object
 - Edit storage class
 - Edit server-side encryption
 - Edit metadata
 - Edit tags
 - Make public using ACL

iv. Retrieve the File URL:

Once the file is uploaded and the ACL is set, each file in the S3 bucket has a unique URL.

You can find this URL in the S3 console by selecting the file. The 'Object URL' is typically in the format: `https://[bucket-name].s3.[region].amazonaws.com/[filename]`.



3-8 Add URL to the DataFrame

To integrate the URLs of our saved bar charts into the 'Crash' DataFrame, we add a new column titled 'URL'. This is achieved by concatenating a base URL with the 'FID' of each roundabout, followed by the '.png' file extension, creating a complete URL for each corresponding bar chart. The base URL points to the location where the charts are stored on the AWS S3 bucket, ensuring each 'URL' column entry is a direct link to the respective bar chart image. We also adjust the DataFrame display settings to ensure the full URLs are visible without truncation.

```
# Assuming 'Crash' is your existing DataFrame
base_url = "https://dospir.s3.us-east-2.amazonaws.com/Roundabout_Crash_Data_Charts/"
# Add a new column 'URL' to the DataFrame
Crash['URL'] = Crash['FID'].apply(lambda x: f"{base_url}{x}.png")
# Set option to display full content in a DataFrame column
pd.set_option('display.max_colwidth', None)
# Display the DataFrame to verify the new 'URL' column
Crash
```

	FID	Year_Open	Avg_Before	Avg_After	URL
0	1	2013.0	0.2500	5.2000	https://dospir.s3.us-east-2.amazonaws.com/Roundabout_Crash_Data_Charts/1.png
1	26	2014.0	0.4000	0.8889	https://dospir.s3.us-east-2.amazonaws.com/Roundabout_Crash_Data_Charts/26.png
2	30	2013.0	0.2500	1.0000	https://dospir.s3.us-east-2.amazonaws.com/Roundabout_Crash_Data_Charts/30.png
3	33	2012.0	5.0000	0.3636	https://dospir.s3.us-east-2.amazonaws.com/Roundabout_Crash_Data_Charts/33.png
4	35	2012.0	0.3333	1.2727	https://dospir.s3.us-east-2.amazonaws.com/Roundabout_Crash_Data_Charts/35.png

3-9 Calculating and Integrating Average Crash Severity and Property Damage

To calculate the average crash severity ('CSEV') and property damage ('PROPDMG') before and after roundabout construction, we will use a custom Python function. This function ensures accurate averaging, even in cases where all data points are zero. It calculates the average 'CSEV' and 'PROPDMG' for each roundabout, separated into 'Before' and 'After' construction

categories. We then group our data by each roundabout's unique identifier ('JOIN_FID') and apply this function. Finally, to focus on relevant roundabouts, we filter these averages to include only those found in our 'Crash' DataFrame, ensuring our analysis is specific and targeted.

```
# Function to calculate average, keeping zero values if they are the only ones present
def calculate_average(df, column):
    if df[column].eq(0).all(): # If all values are zero
        return 0
    else:
        return df[df[column] != 0][column].mean() # Calculate average excluding zeros

# Group by 'JOIN_FID' and calculate averages using the custom function
avg_df = df_total.groupby('JOIN_FID').apply(lambda x: pd.Series({
    'CSEV_Before': calculate_average(x[x['standard'] == 'Before'], 'CSEV'),
    'CSEV_After': calculate_average(x[x['standard'] == 'After'], 'CSEV'),
    'PROPDGMG_Before': calculate_average(x[x['standard'] == 'Before'], 'PROPDGMG'),
    'PROPDGMG_After': calculate_average(x[x['standard'] == 'After'], 'PROPDGMG')
})).reset_index()

# Filter out rows where 'JOIN_FID' is not in Crash's unique FID list
unique_fid_list = Crash['FID'].unique()
avg_df = avg_df[avg_df['JOIN_FID'].isin(unique_fid_list)]

# Display the resulting DataFrame
avg_df.head()
```

	JOIN_FID	CSEV_Before	CSEV_After	PROPDGMG_Before	PROPDGMG_After
0	1	3.0	1.250000	13500.0	3939.423077
3	26	1.5	1.000000	3000.0	7306.250000
4	30	1.0	1.200000	7500.0	3878.000000
5	33	1.8	1.000000	9280.0	9325.000000
7	35	1.0	1.142857	2500.0	4310.714286

Next, we will create a new DataFrame, 'Average', as a copy of the previously created 'Crash' DataFrame. Into 'Average', we will integrate the calculated average crash severity and property damage data. This integration is done by merging 'Average' with our calculated averages dataframe ('avg_df'), ensuring that each roundabout's unique identifier ('FID') in 'Crash' aligns with 'JOIN_FID' in 'avg_df'. After the merge, we'll drop any redundant columns and refine the data, including rounding specific columns to the desired decimal places and converting identifier columns to integers.

```
# Create a copy of the 'Crash' DataFrame
Average = Crash.copy()

# Merge 'Average' with 'avg_df'
# Ensure that 'JOIN_FID' in 'avg_df' matches 'FID' in 'Average'
Average = Average.merge(avg_df, left_on='FID', right_on='JOIN_FID', how='left')

# Drop the extra 'JOIN_FID' column if not needed
Average.drop('JOIN_FID', axis=1, inplace=True)

# Round 'Avg_Before' and 'Avg_After' to four decimal places
Average['Avg_Before'] = Average['Avg_Before'].round(4)
Average['Avg_After'] = Average['Avg_After'].round(4)

# Convert 'FID' and 'Year_Open' to integers
Average['FID'] = Average['FID'].astype(int)
Average['Year_Open'] = Average['Year_Open'].astype(int)

# Round the other specified columns to three decimal places
columns_to_round = ['Crash_Before', 'Crash_After', 'CSEV_Before', 'CSEV_After',
                    'PROPDGMG_Before', 'PROPDGMG_After', 'Avg_Before', 'Avg_After']
Average[columns_to_round] = Average[columns_to_round].round(3)

# Display the updated DataFrame
Average.head()
```

	FID	Year_Open	Crash_Before	Crash_After	URL	CSEV_Before	CSEV_After	PROPDGMG_Before	PROPDGMG_After	Avg_Before	Avg_After
0	1	2013	0.250	5.200	https://dospir.s3.us-east-2.amazonaws.com/Roundabout_Crash_Data_Charts/1.png	3.0	1.250	13500.0	3939.423	0.250	5.200
1	26	2014	0.400	0.889	https://dospir.s3.us-east-2.amazonaws.com/Roundabout_Crash_Data_Charts/26.png	1.5	1.000	3000.0	7306.250	0.400	0.889
2	30	2013	0.250	1.000	https://dospir.s3.us-east-2.amazonaws.com/Roundabout_Crash_Data_Charts/30.png	1.0	1.200	7500.0	3878.000	0.250	1.000
3	33	2012	5.000	0.364	https://dospir.s3.us-east-2.amazonaws.com/Roundabout_Crash_Data_Charts/33.png	1.8	1.000	9280.0	9325.000	5.000	0.364
4	35	2012	0.333	1.273	https://dospir.s3.us-east-2.amazonaws.com/Roundabout_Crash_Data_Charts/35.png	1.0	1.143	2500.0	4310.714	0.333	1.273

To export this DataFrame 'Average' to an excel file, you can use 'to_excel' method provided by pandas.

```
# Export the DataFrame 'Average' to an Excel file
excel_filename = 'data/Average_Data.xlsx'
Average.to_excel(excel_filename, index=False)
print(f'{excel_filename} has been saved.')
```

	A	B	C	D	E	F	G	H	I
1	FID	Year_Open	Crash_B	Crash_A	URL	CSEV_B	CSEV_A	PROPDMG_B	PROPDMG_A
2	1	2013	0.25	5.2	https://dospir.s3.us-east-2.amazonaws.com/Roundabout_Crash_Data_Charts/1.png	3	1.25	13500	3939.423
3	26	2014	0.4	0.889	https://dospir.s3.us-east-2.amazonaws.com/Roundabout_Crash_Data_Charts/26.png	1.5	1	3000	7306.25
4	30	2013	0.25	1	https://dospir.s3.us-east-2.amazonaws.com/Roundabout_Crash_Data_Charts/30.png	1	1.2	7500	3878
5	33	2012	5	0.364	https://dospir.s3.us-east-2.amazonaws.com/Roundabout_Crash_Data_Charts/33.png	1.8	1	9280	9325
6	35	2012	0.333	1.273	https://dospir.s3.us-east-2.amazonaws.com/Roundabout_Crash_Data_Charts/35.png	1	1.143	2500	4310.714
7	36	2012	1	0.727	https://dospir.s3.us-east-2.amazonaws.com/Roundabout_Crash_Data_Charts/36.png	1	1	2500	3490
8	38	2012	1	1.818	https://dospir.s3.us-east-2.amazonaws.com/Roundabout_Crash_Data_Charts/38.png	2	1.1	2233.333	4452.5
9	42	2013	5.75	14	https://dospir.s3.us-east-2.amazonaws.com/Roundabout_Crash_Data_Charts/42.png	1.261	1.279	6715.217	5717.307
10	43	2013	2.25	1.7	https://dospir.s3.us-east-2.amazonaws.com/Roundabout_Crash_Data_Charts/43.png	1.556	1.412	8222.222	6887.824

4. Enhancing ArcGIS Pro Maps with Interactive Charts and Data Pop-ups

To enhance the interactivity of our ArcGIS Pro map, we will integrate the charts and dataframe that we have meticulously prepared. This task is accomplished using two pivotal functionalities within ArcGIS Pro. Initially, we'll employ the "Calculate Field" tool, a more stable alternative to exporting dataframes through a Jupyter Notebook—a method which, while possible, tends to be susceptible to crashes and lacks reliability. By leveraging "Calculate Field," we can seamlessly modify and incorporate our data into the active map layer.

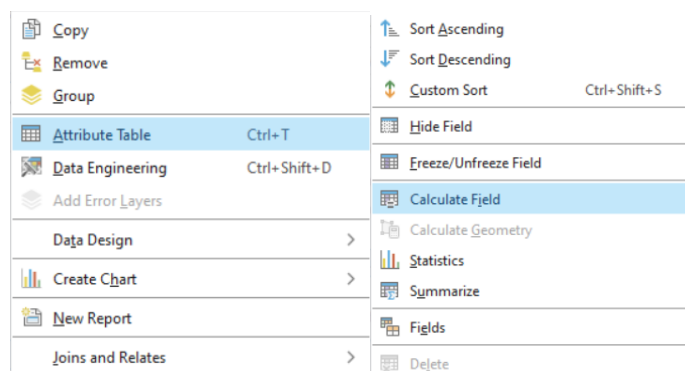
Following this integration, we will enrich the map's user experience by configuring pop-ups with the "Configure Pop-ups" feature. This will not only display the geographic information but will also imbue the map with dynamic visual elements and provide data-driven insights via the interactive charts and pop-ups, making the map both informative and engaging.

4-1. Establishing a Persistent "Rndbt_ID" Identifier Column

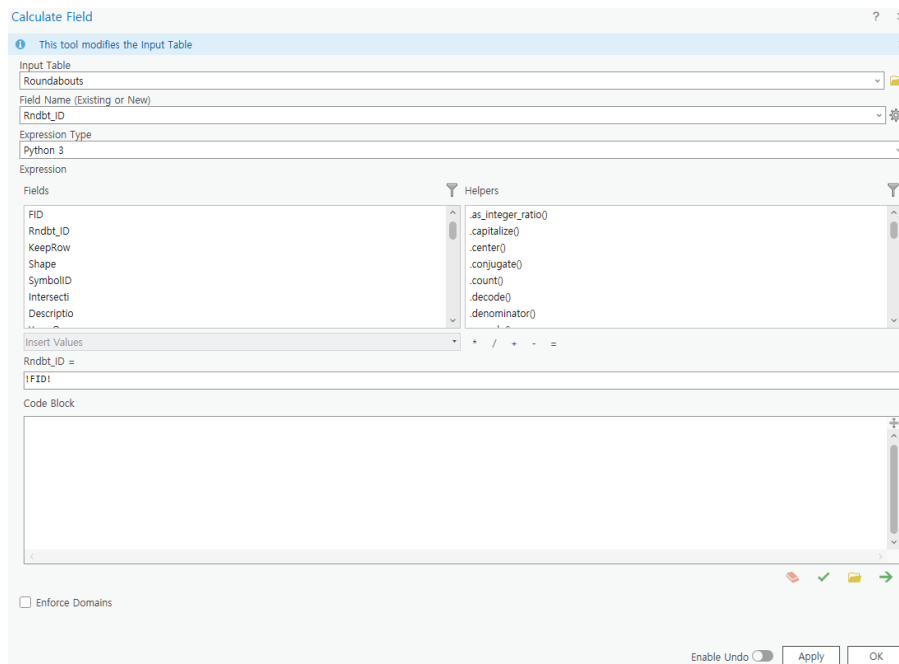
In the "Roundabouts" layer, the "FID" column uniquely identifies each row. However, these identifiers are subject to change during certain operations, such as when rows are deleted, or the dataset is otherwise altered. To preserve the original "FID" values and maintain a consistent reference to each roundabout, we will create a new column named "Rndbt_ID". This new field will duplicate the current "FID" values, ensuring that the original identifiers remain unaltered regardless of subsequent modifications to the layer.

Here's how we accomplish this:

1. Begin by right-clicking on the 'Roundabouts' layer in ArcGIS Pro and selecting "Attribute Table" to open it.
2. Once the attribute table is open, right-click on any column header and choose "Calculate Field."



3. Configure the tool by selecting "Rndbt_ID" as the field to calculate, and simply set the expression to !FID!, which instructs ArcGIS Pro to copy the "FID" field values directly into "Rndbt_ID".
4. Choose "Long Integer" as the field type to support whole number identifiers.



5. Execute the calculation. The "Rndbt_ID" column will now mirror the "FID" column, creating a stable and unchanging identifier for each roundabout feature.

	FID	Rndbt_ID	KeepRow	Shape *	SymbolID	Intersecti	Descriptio	Year_Open
1	0	0	0	Point ZM	0	Bass Pro Dr & Prairie Fi...	Multi-lane in new com...	2009
2	1	1	1	Point ZM	0	Irwindale Dr & Vintage...	Replacing all-way stop	2013
3	2	2	0	Point ZM	0	SW Cherry St & SW 11...	New roadway adjacen...	2011
4	3	3	0	Point ZM	0	SW Snyder Blvd & SW...	New residential devel...	2006
5	4	4	0	Point ZM	0	NW 13th Street & NW...	New residential devel...	2005

4-2. Removing Unnecessary Rows Using the "Calculate Field" Tool

To streamline our "Roundabouts" layer by removing unnecessary rows, we will once again utilize the "Calculate Field" tool. This time, the tool will be used to flag roundabouts that we wish to retain, facilitating manual deletion of unwanted rows. The list of Roundabout IDs to be kept corresponds with the values in the FID column that we previously exported to an Excel file (DataFrame 'Average').

Here's the step-by-step process for our "Roundabouts" layer:

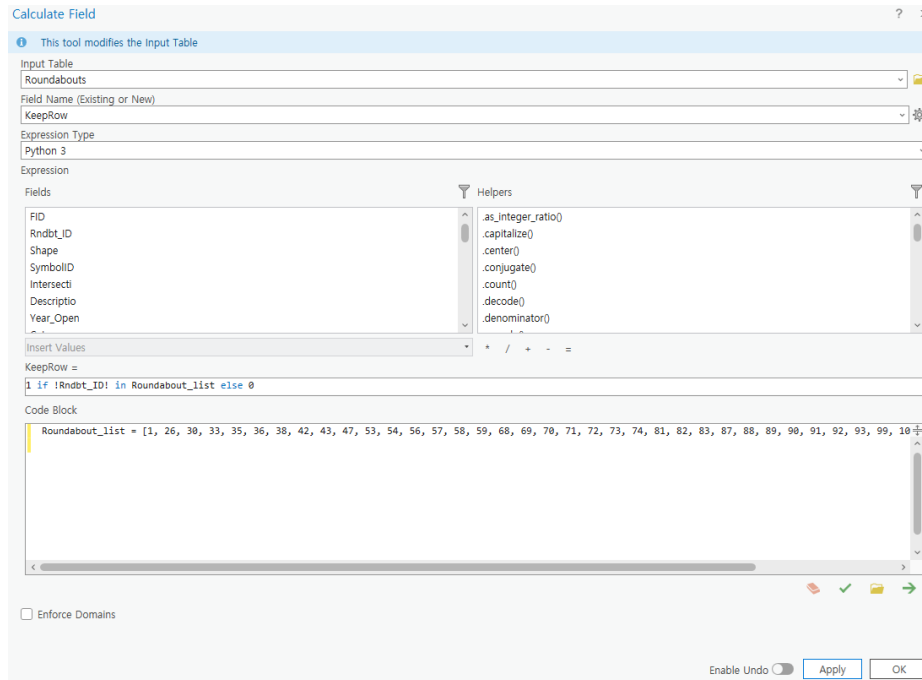
1. Open the "Calculate Field" tool in ArcGIS Pro.
2. Add a new field named "KeepRow" to the layer. This field will act as a flag, indicating whether a row should be kept (1) or not (0).
3. Inside the tool's Code Block, define your list of FIDs as follows:

```
>>> Roundabout_list = [1, 26, 30, 33, 35, 36, 38, 42, 43, 47, 53, 54, 56, 57, 58, 59, 68, 69, 70, 71, 72, 73, 74, 81, 82, 83, 87, 88, 89, 90, 91, 92, 93, 99, 103, 104]
```

4. Set the expression in the tool to:

```
>>> 1 if !Rndbt_ID! in Roundabout_list else 0
```

5. Execute the "Calculate Field" tool.



To finalize the removal of unwanted rows, proceed as follows:

6. Sort the "KeepRow" column in ascending order within the attribute table. This will group all rows with a '0' together.

7. Select these rows and use the 'Delete Rows' command to remove them from the layer.

	FID	KeepRow	Shape *	Intersecti	SymbolID	Description	Year_Open
1	1	1	Point ZM	Irwindale Dr & Vintage...	0	Replacing all-way stop	2013
2	26	1	Point ZM	Commerce Dr & Comm...	0	Rebuilt 4-leg intersecti...	2014
3	30	1	Point ZM	Co Rd E23 & Matthew...	0	Between 3 schools; Re...	2013
4	33	1	Point ZM	US 218 southbound ra...	0	Diamond interchange...	2012
5	35	1	Point ZM	NW 62nd Ave & Pione...	0	1 of 4 on 62nd Ave cor...	2012

By following these steps, we ensure that our "Roundabouts" layer is streamlined to include only the essential records. This refinement is guided by the predetermined list of FID values, which was meticulously compiled during our earlier data preprocessing phase using Python.

4-3. Importing Excel Data and Performing Table Joins in ArcGIS Pro

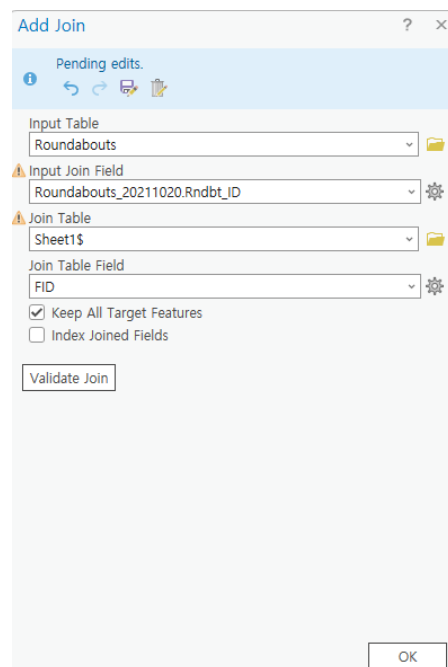
In this section, we focus on importing the 'Average_Data' Excel file into ArcGIS Pro and executing a table join with the 'Roundabouts' layer.

1. Importing the 'Average_Data' Excel File:

- Begin by opening ArcGIS Pro and accessing the 'Map' tab.
- Use the 'Add Data' option and select 'Add Data from File' to import the 'Average_Data.xlsx' file.
- Locate and select your Excel file, integrating it as a new table in your project.

2. Executing a Table Join:

- Right-click on the 'Roundabouts' layer in the Contents pane.
- Navigate to 'Joins and Relates' and choose 'Add Join'.
- In the 'Add Join' dialog, select the 'Rndbt_ID' field from the 'Roundabouts' layer.
- Then, select the imported 'Average_Data' table and its 'FID' field.
- The join operation will append the fields from 'Average_Data' to the 'Roundabouts' layer, based on the matching criteria between 'Rndbt_ID' and 'FID'.

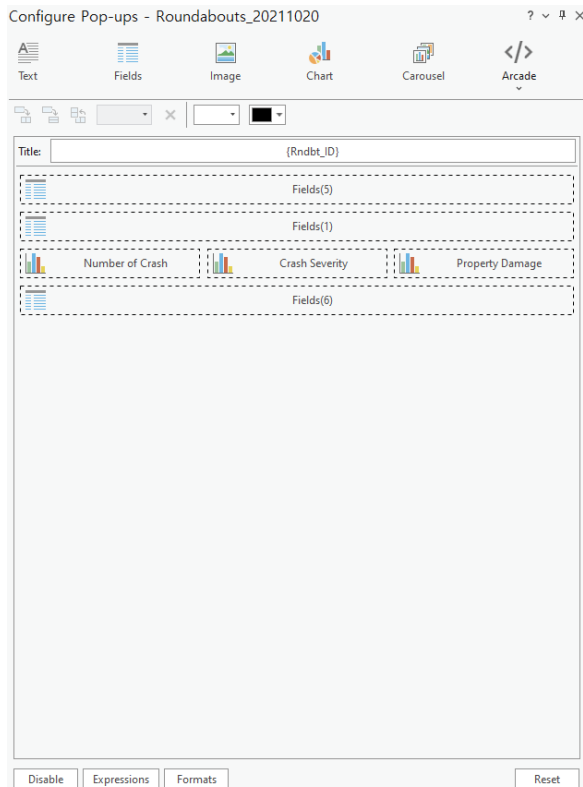


After performing the "Add Join" operation, your attribute table should display additional columns from the 'Average_Data' table alongside the existing 'Roundabouts' layer fields, as illustrated below:

	FID	Rndbt_ID	Shape *	Descriptio	Year_Open	Category	City	County	Crash_A	Crash_B	CSEV_A	CSEV_B	PROPDMG_A	PROPDMG_B	URL
1	0	1	Point ZM	Replacing all-way stop	2013	Modern Roundabout	Ankeny	Polk	5.2	0.25	1.25	3	3939.423	13500	https://dospir.s3.us-east
2	1	26	Point ZM	Rebuilt 4-leg intersecti...	2014	Modern Roundabout	Coralville	Johnson	0.889	0.4	1	1.5	7306.25	3000	https://dospir.s3.us-east
3	2	30	Point ZM	Between 3 schools; Re...	2013	Modern Roundabout	Gilbert	Story	1	0.25	1.2	1	3878	7500	https://dospir.s3.us-east
4	3	33	Point ZM	Diamond interchange...	2012	Modern Roundabout	Janesville	Bremer	0.364	5	1	1.8	9325	9280	https://dospir.s3.us-east
5	4	35	Point ZM	1 of 4 on 62nd Ave cor...	2012	Modern Roundabout	Johnston	Polk	1.273	0.333	1.143	1	4310.714	2500	https://dospir.s3.us-east

4-4. Customizing Pop-Up Displays for the "Roundabouts" Layer

The next step in our DOSPIR is to enhance the interactivity of the "Roundabouts" layer by configuring custom pop-ups. These pop-ups will activate when a point on the map is clicked, displaying a tailored window of information that caters to the specific needs and interests of the users. By setting up pop-ups, we can provide immediate access to detailed data, such as annual crash statistics, directly within the map's interface, improving the user experience and offering insightful context at a glance. The configuration of these pop-ups will be designed to meet user requirements, ensuring that the most relevant and useful information is presented efficiently.



- Access the Configure Pop-ups Window:
 Right-click on the layer for which you want to configure pop-ups and select "Configure Pop-ups".
- Customize the Pop-up Content:
 The pop-up configuration window will appear, displaying various elements that you can add or adjust.
 The title of the pop-up can be set to show a unique identifier or name from the feature, such as "Rndbt_ID" in this case.
- Adding Fields and Charts:
 To display specific data, click on the "Fields" option to choose which attributes from the layer you want to show in the pop-up.

To add a visual element, click on the "Chart" option to create a chart that graphically represents the attribute data, making the pop-up more informative and engaging.

Chart Options

HTML mode

Type

Field

Tahoma

9

B

/

U

Title

Number of Crash

Caption

Left: Before / Right: After

Fields

Display	Field Alias (Field Name)
<input checked="" type="checkbox"/>	Crash_B {Crash_B}
<input checked="" type="checkbox"/>	Crash_A {Crash_A}

To display the Annual Crash Data for each roundabout, we will create a field within the pop-up that exclusively shows the "URL". This URL links to the corresponding bar charts hosted on AWS S3, which we have prepared earlier.

Title

Annual Crash Data

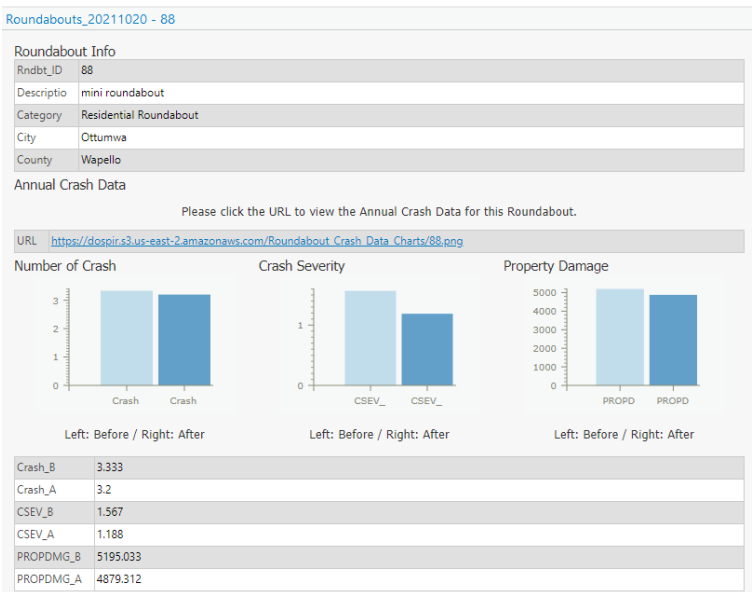
Caption

Please click the URL to view the Annual Crash Data for this Roundabout.

☐ Only use visible fields and Arcade expressions

Display	Field Alias (Field Name)
<input checked="" type="checkbox"/>	URL {URL}

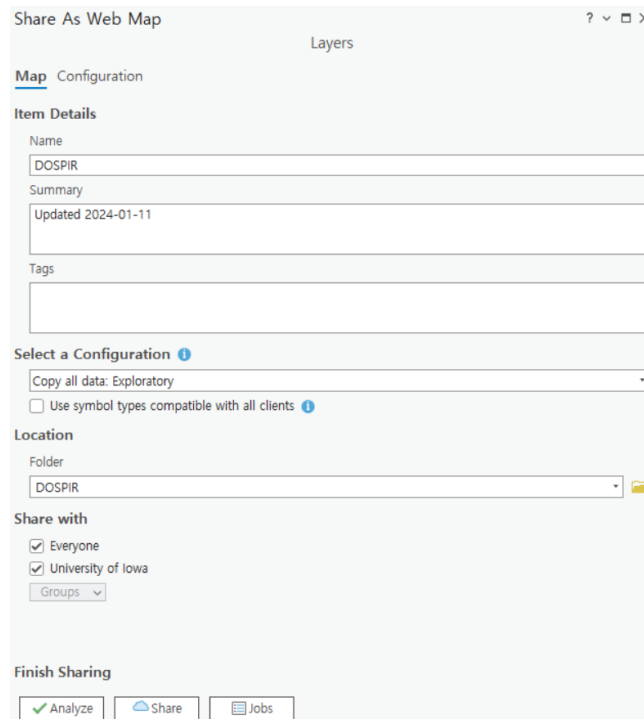
Once satisfied with the configuration, you can save your settings, and these pop-ups will be enabled for the layer.



5. Publishing the Updated Layer Online

The next step in our GIS project is to publish the newly updated "DOSPIR" layer as a Web Map to our ArcGIS online account. This process will involve:

- Naming the map package "DOSPIR."
- Saving it within a designated folder in the ArcGIS online account.
- Clicking 'Analyze' to inspect the package for any potential issues.



Share As Web Map

Layers

Map Configuration

Item Details

Name
DOSPIR

Summary
Updated 2024-01-11

Tags

Select a Configuration ⓘ
Copy all data: Exploratory

☐ Use symbol types compatible with all clients ⓘ

Location

Folder
DOSPIR

Share with

☒ Everyone
☒ University of Iowa
Groups

Finish Sharing

During the analysis phase, it's common to encounter warnings or errors related to layer properties or ArcGIS Pro configurations. These can be addressed by reviewing the error messages and making the necessary adjustments directly within the tool. Once all issues have been resolved and the package is free of errors, we're ready to share "DOSPIR" online, thereby providing access to a wider audience and extending the reach of our GIS data beyond the confines of ArcGIS Pro.

To view the "DOSPIR" Web Map, begin by opening a web browser and heading to the ArcGIS Online portal at <https://www.arcgis.com>. Log in with your ArcGIS Online account credentials. Once logged in, proceed to the "My Content" section where you can find all your saved items. In the designated folder where you uploaded the "DOSPIR" Web Map, you will be able to see and manage your file. This is where you can perform various actions such as viewing the map, editing its properties, or sharing it with others.

HomeGalleryMapSceneNotebookGroupsContentOrganization

JB Lee
jlee231@uiowa.edu_uiowa

Search

Notifications

More

Content

My ContentMy FavoritesMy GroupsMy OrganizationLiving Atlas

New itemCreate app

Search DOSPIR

TableDate modifiedFilters

Folders

Filter folders

All my content

jlee231@uiowa.edu_uiowa

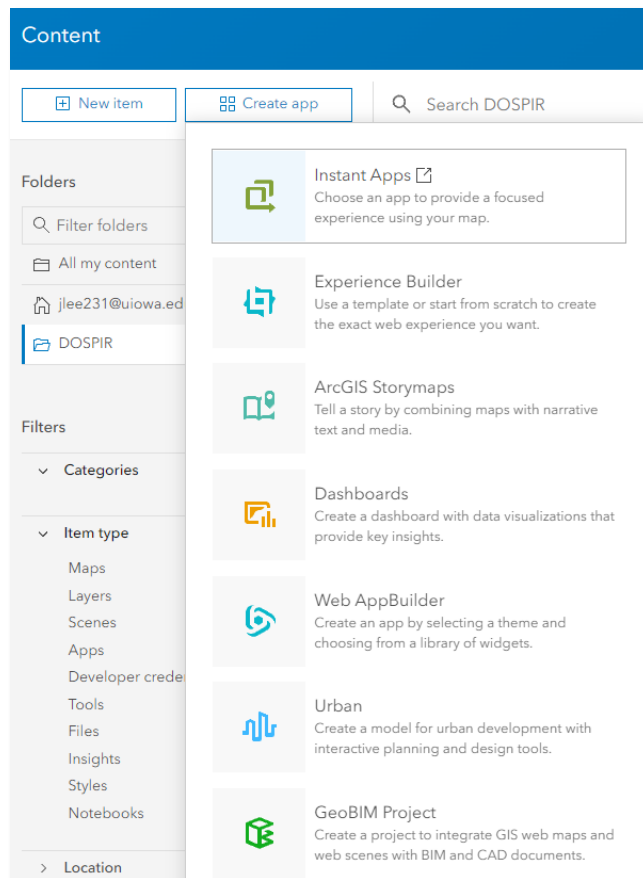
DOSPIR

1 - 3 of 3 in DOSPIR

Title				Modified
DOSPIR	Web Map		☆ ...	Jan 11, 2024
DOSPIR_WFL1	Feature layer (hosted)		☆ ...	Jan 11, 2024
DOSPIR_WFL1	Service definition		☆ ...	Jan 11, 2024

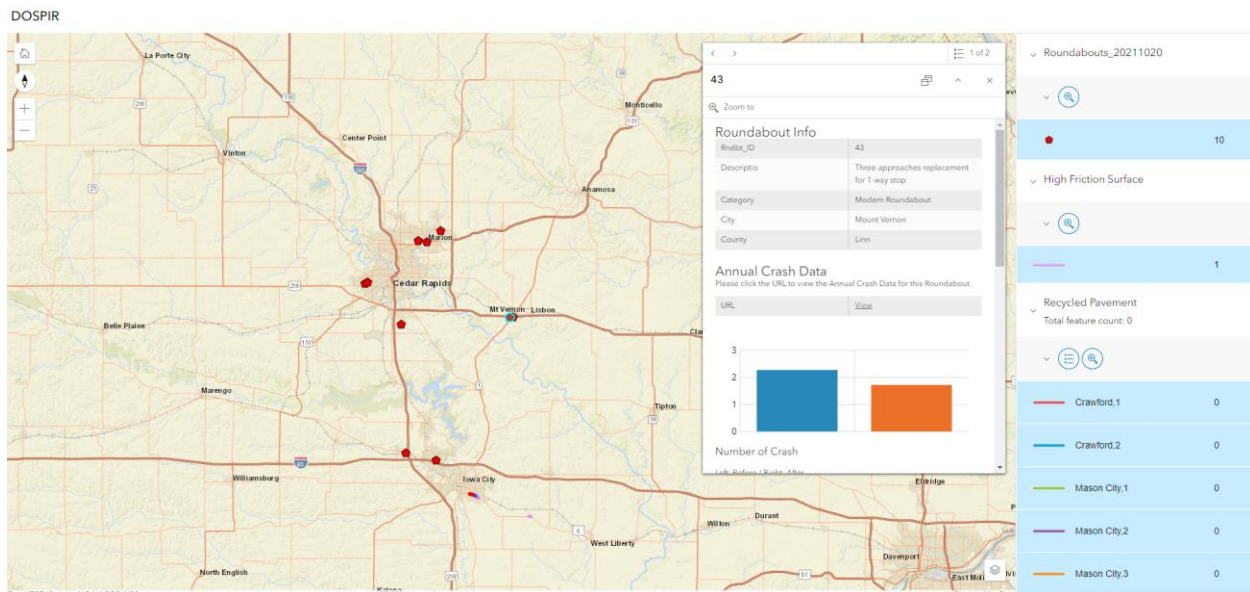
6. Leveraging the DOSPIR Web Map for Various Applications

The DOSPIR Web Map on ArcGIS Online can serve multiple purposes depending on the objectives set for the database. For instance, to provide users with an intuitive and engaging way to explore the data, one could create an "Instant App" featuring an Interactive Legend. This type of app streamlines the process of sharing GIS information by offering a ready-to-use application with customizable options. Here's a brief overview of creating an Instant App:



- Select the DOSPIR Web Map: Navigate to the DOSPIR Web Map in your ArcGIS Online content and select it.
- Choose to Create an App: From the item details page, look for the option to create an app and select "Instant Apps" from the available choices.
- Configure the App: Select a template that suits your presentation needs, such as one with an Interactive Legend if you wish to allow users to toggle map layers on and off.
- Customize App Settings: Tailor the app's settings to enhance the user experience. This includes configuring the legend, map extent, search options, and more, depending on the chosen template.
- Preview and Publish: Before making the app public, preview it to ensure it meets your requirements. Once satisfied, publish the app so it becomes accessible to your intended audience.

Creating an Instant App in this manner allows for the effective dissemination of the DOSPIR database, catering to interactive and informative user experiences.



<https://uiowa.maps.arcgis.com/apps/instant/interactivelegend/index.html?appid=e8fd8f3be8e64153813b3edae9d88675>

6-1. Embedding the DOSPIR Instant App into Your Webpage

Upon successfully publishing the DOSPIR Instant App, ArcGIS Online provides you with an HTML iframe code snippet. This embed code is the key to incorporating the DOSPIR interactive map within your own website, granting users the convenience of exploring the map directly on the page. To integrate the DOSPIR Web Map, simply place the iframe code into the appropriate section of your website's HTML. This integration ensures that visitors can fully engage with the DOSPIR map's features and data without the need to navigate away from your webpage.

Share ×

</> Embed

```
<iframe
src="https://uiowa.maps.arcgis.com/apps/i
nstant/interactivelegend/index.html?
appid=a1066dd52f3c428996996b317c0e
101e" width="400" height="600"
frameborder="0" style="border:0">
```

Copy

Date published: 1/11/2024, 11:01 AM

Width: 400 Height: 600

Close Launch