

## Technical Memorandum

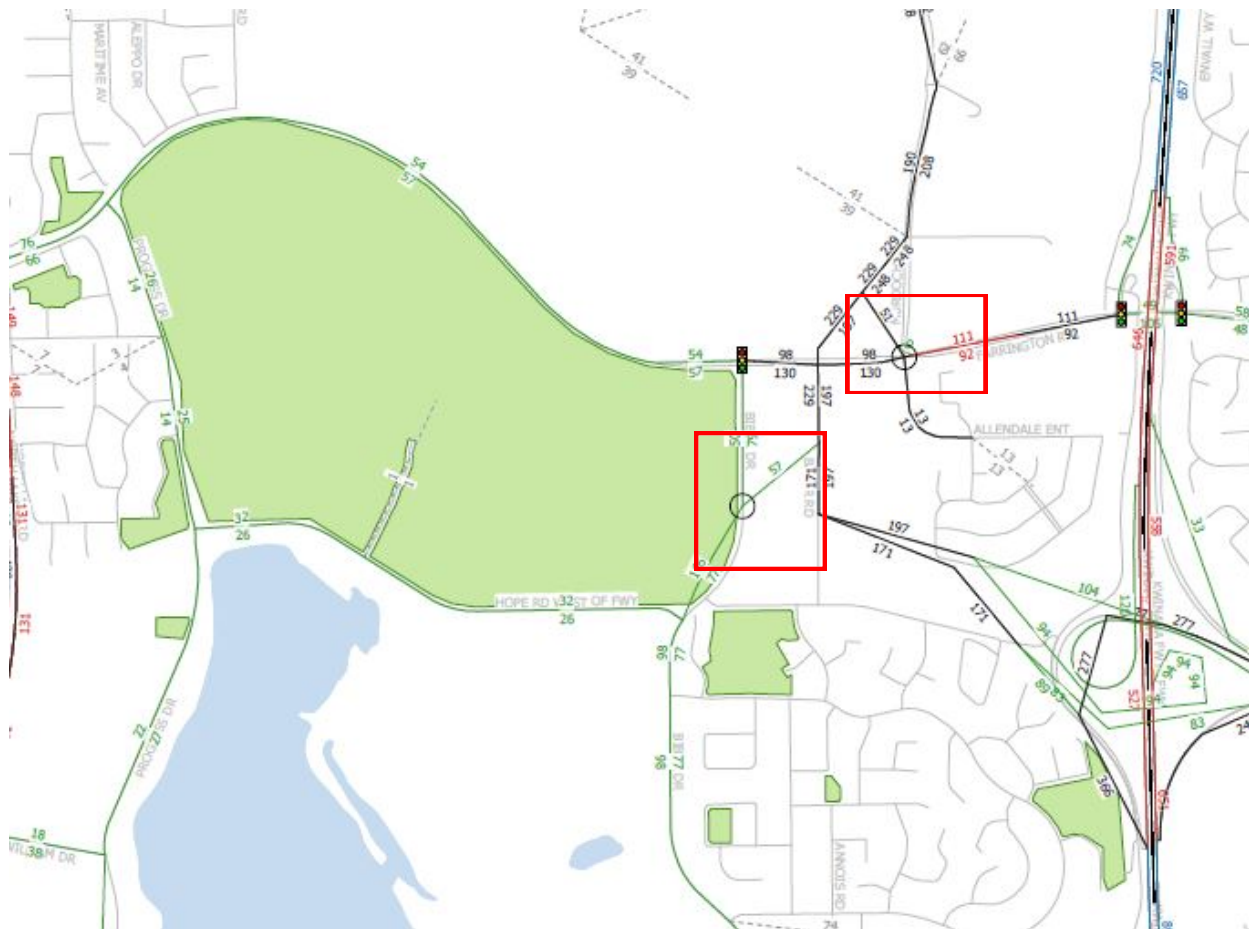
<b>Title</b>	Murdoch Drive Connection - Roundabout Analysis		
<b>Client</b>	City of Cockburn	<b>Project No</b>	CW1004500
<b>Date</b>	Prepared 17/10/2017	<b>Status</b>	Rev A
<b>Author</b>	Andrew Barry	<b>Discipline</b>	Civil Infrastructure and Property
<b>Reviewer</b>	Andreas Want	<b>Office</b>	Perth

### **RE: Murdoch Drive Cardno Assessment of MRWA Option 4**

MRWA have undertaken additional ROM modelling based on networks aligning to drawing 10-0100-010-RD-SK-1084 Rev A. This amended drawing limits access from the proposed Murdoch Drive Connection to Farrington Road and provides access from Bibra Drive to the Murdoch Drive Connection.

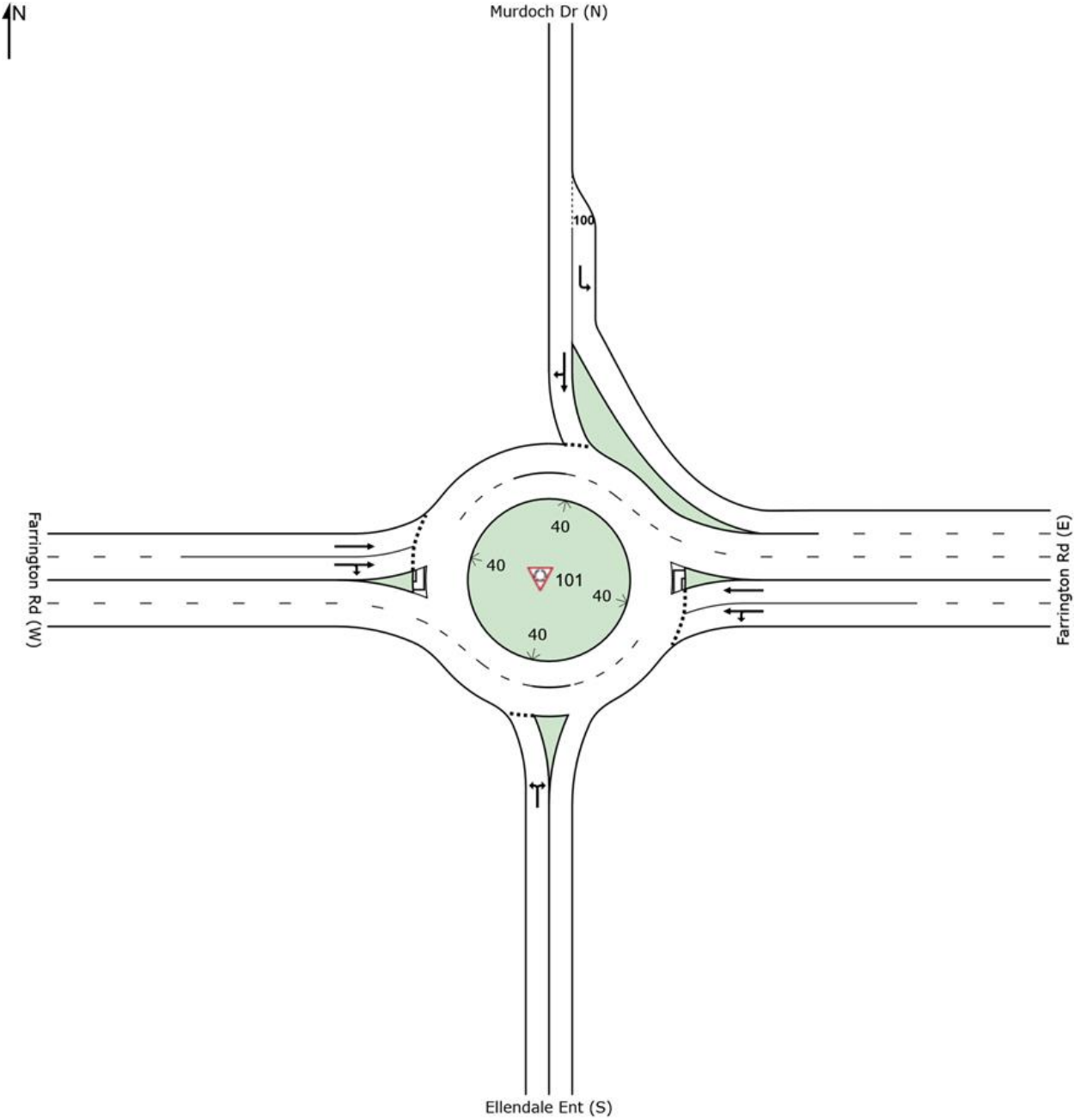
Drawing 10-0100-010-RD-SK-1084 Rev A most closely to concepts provided by the City of Cockburn and Cardno to the MRWA. The MRWA ROM outputs suggests that there will be a significant reduction in the flow of traffic routed to/from Roe Highway to the City of Cockburn and the City of Melville. The 2-way traffic is considered to reduce from 51,700 vpd (10-0100-010-RD-SK-1082 Rev A) to 36,800 vpd.

Two key roundabouts have been assessed against MRWA 2021 & 2031 ROM data using Sidra as part of this review:



**Study Area - Source: 2021 ROM 24 FS-BFS-Scen 14(MRIA Concept Design\_Option2)**

### Roundabout 1 - Murdoch Drive / Farrington Road / Allendale Entrance



**SIDRA layout:**

## 2021 AM

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Ellendale Ent (S)											
1	L2	108	0.0	0.184	6.3	LOS A	0.8	5.8	0.68	0.81	53.3
3	R2	23	0.0	0.184	12.7	LOS B	0.8	5.8	0.68	0.81	56.7
Approach		131	0.0	0.184	7.4	LOS A	0.8	5.8	0.68	0.81	53.9
East: Farrington Rd (E)											
4	L2	15	0.0	0.369	4.3	LOS A	2.7	19.5	0.53	0.41	54.6
5	T1	989	3.0	0.369	4.3	LOS A	2.7	19.5	0.55	0.43	56.2
Approach		1005	3.0	0.369	4.3	LOS A	2.7	19.5	0.54	0.43	56.2
North: Murdoch Dr (N)											
7	L2	46	6.0	0.025	2.8	LOS A	0.0	0.0	0.00	0.36	57.8
8	T1	4	0.0	0.214	5.3	LOS A	0.9	6.8	0.61	0.82	52.3
9	R2	215	6.0	0.214	12.1	LOS B	0.9	6.8	0.61	0.82	52.2
Approach		264	5.9	0.214	10.4	LOS B	0.9	6.8	0.50	0.74	53.2
West: Farrington Rd (W)											
11	T1	1071	6.0	0.342	3.0	LOS A	2.8	20.3	0.15	0.31	58.5
12	R2	79	0.0	0.342	9.6	LOS A	2.7	19.5	0.16	0.35	58.9
Approach		1150	5.6	0.342	3.4	LOS A	2.8	20.3	0.15	0.31	58.5
All Vehicles		2549	4.3	0.369	4.7	LOS A	2.8	20.3	0.37	0.43	56.7

## 2021 PM

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Ellendale Ent (S)											
1	L2	49	0.0	0.115	5.8	LOS A	0.5	3.6	0.62	0.77	52.3
3	R2	43	0.0	0.115	12.2	LOS B	0.5	3.6	0.62	0.77	55.6
Approach		92	0.0	0.115	8.8	LOS A	0.5	3.6	0.62	0.77	53.8
East: Farrington Rd (E)											
4	L2	37	0.0	0.245	4.8	LOS A	1.7	12.4	0.60	0.47	54.3
5	T1	557	3.0	0.245	4.8	LOS A	1.7	12.4	0.61	0.49	55.8
Approach		594	2.8	0.245	4.8	LOS A	1.7	12.4	0.61	0.49	55.7
North: Murdoch Dr (N)											
7	L2	331	6.0	0.179	2.8	LOS A	0.0	0.0	0.00	0.36	57.8
8	T1	25	0.0	0.349	4.7	LOS A	1.6	11.6	0.57	0.77	52.8
9	R2	370	6.0	0.349	11.5	LOS B	1.6	11.6	0.57	0.77	52.7
Approach		725	5.8	0.349	7.3	LOS A	1.6	11.6	0.31	0.58	54.9
West: Farrington Rd (W)											
11	T1	668	6.0	0.219	3.1	LOS A	1.5	11.0	0.18	0.32	58.2
12	R2	50	0.0	0.219	9.6	LOS A	1.4	10.5	0.19	0.36	58.7
Approach		717	5.6	0.219	3.5	LOS A	1.5	11.0	0.19	0.32	58.3
All Vehicles		2128	4.6	0.349	5.4	LOS A	1.7	12.4	0.36	0.48	56.2

## 2031 AM

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows		Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
		Total veh/h	HV %				Vehicles veh	Distance m			
South: Ellendale Ent (S)											
1	L2	96	0.0	0.203	7.2	LOS A	1.0	6.8	0.76	0.87	52.5
3	R2	25	0.0	0.203	13.6	LOS B	1.0	6.8	0.76	0.87	55.8
Approach		121	0.0	0.203	8.5	LOS A	1.0	6.8	0.76	0.87	53.2
East: Farrington Rd (E)											
4	L2	18	0.0	0.475	4.8	LOS A	3.9	28.2	0.65	0.46	54.0
5	T1	1205	3.0	0.475	4.8	LOS A	3.9	28.2	0.66	0.48	55.5
Approach		1223	3.0	0.475	4.8	LOS A	3.9	28.2	0.66	0.48	55.5
North: Murdoch Dr (N)											
7	L2	72	6.0	0.039	2.8	LOS A	0.0	0.0	0.00	0.36	57.8
8	T1	4	0.0	0.299	6.0	LOS A	1.4	10.4	0.69	0.86	52.1
9	R2	281	6.0	0.299	12.8	LOS B	1.4	10.4	0.69	0.86	51.9
Approach		357	5.9	0.299	10.7	LOS B	1.4	10.4	0.55	0.76	53.0
West: Farrington Rd (W)											
11	T1	1286	6.0	0.405	3.0	LOS A	3.6	26.7	0.17	0.31	58.4
12	R2	75	0.0	0.405	9.6	LOS A	3.5	25.7	0.18	0.34	59.0
Approach		1361	5.7	0.405	3.4	LOS A	3.6	26.7	0.17	0.31	58.4
All Vehicles		3062	4.4	0.475	5.0	LOS A	3.9	28.2	0.43	0.45	56.3

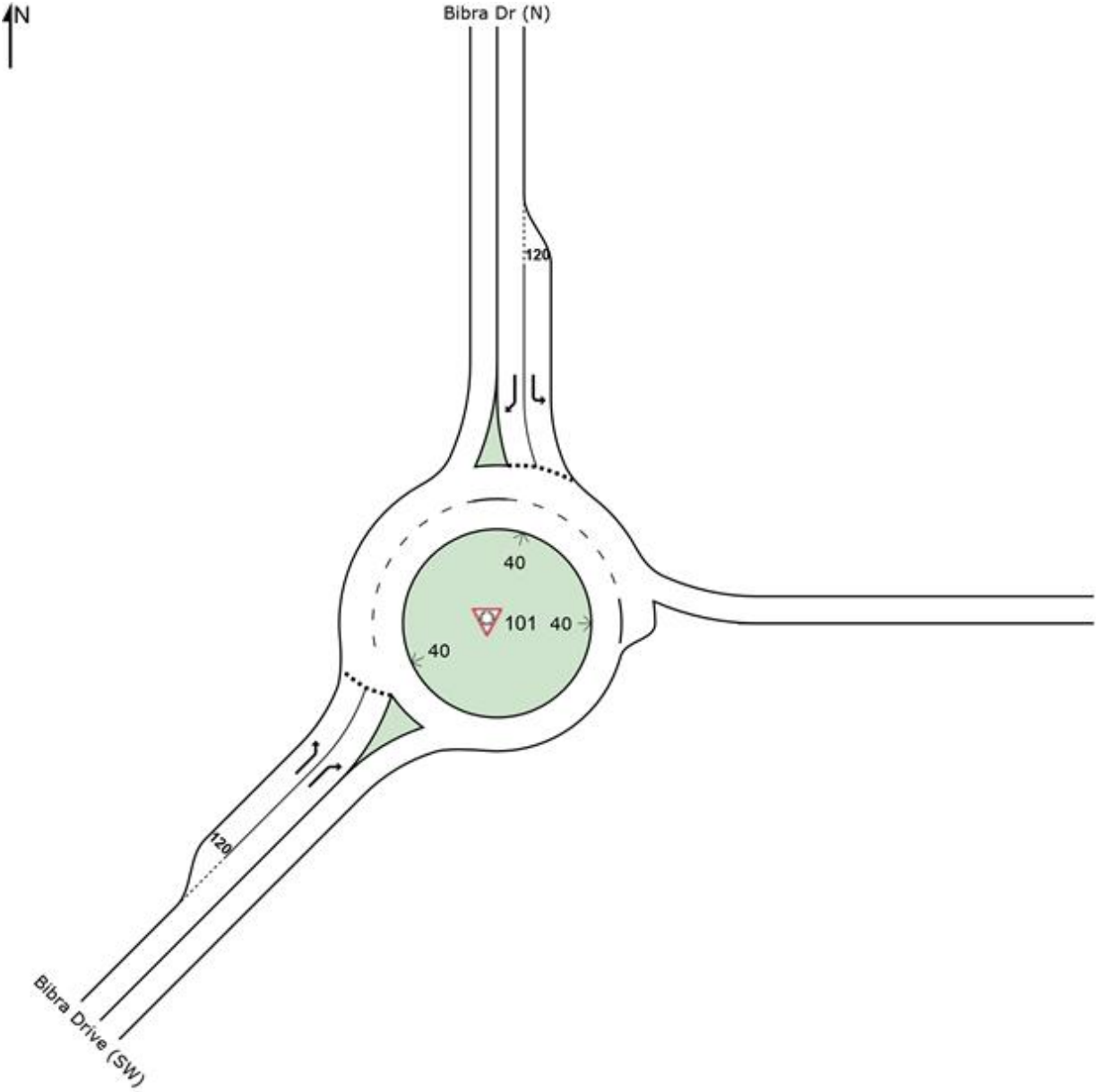
## 2031 PM

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows		Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
		Total veh/h	HV %				Vehicles veh	Distance m			
South: Ellendale Ent (S)											
1	L2	44	0.0	0.125	6.7	LOS A	0.6	4.1	0.70	0.83	51.6
3	R2	41	0.0	0.125	13.1	LOS B	0.6	4.1	0.70	0.83	54.9
Approach		85	0.0	0.125	9.8	LOS A	0.6	4.1	0.70	0.83	53.2
East: Farrington Rd (E)											
4	L2	38	0.0	0.335	5.6	LOS A	2.7	19.2	0.74	0.54	53.5
5	T1	686	3.0	0.335	5.7	LOS A	2.7	19.2	0.75	0.58	55.0
Approach		724	2.8	0.335	5.7	LOS A	2.7	19.2	0.75	0.57	54.9
North: Murdoch Dr (N)											
7	L2	463	6.0	0.251	2.8	LOS A	0.0	0.0	0.00	0.36	57.8
8	T1	27	0.0	0.475	5.7	LOS A	2.6	19.3	0.65	0.87	52.4
9	R2	491	6.0	0.475	12.4	LOS B	2.6	19.3	0.65	0.87	52.3
Approach		981	5.8	0.475	7.7	LOS A	2.6	19.3	0.34	0.63	54.8
West: Farrington Rd (W)											
11	T1	803	6.0	0.259	3.1	LOS A	1.9	13.9	0.19	0.32	58.3
12	R2	47	0.0	0.259	9.6	LOS A	1.8	13.3	0.20	0.35	58.8
Approach		849	5.7	0.259	3.4	LOS A	1.9	13.9	0.19	0.32	58.3
All Vehicles		2638	4.8	0.475	5.8	LOS A	2.7	19.3	0.42	0.52	55.8

## Findings

For the Murdoch Drive / Farrington Road / Allendale Entrance roundabout, the Sidra analysis shows that this roundabout will operate with acceptable Level of Service (LOS) for all scenarios.

### Roundabout 2 - Bibra Drive / Murdoch Drive Connection



SIDRA Layout

## 2021 AM

Movement Performance - Vehicles												
Mov ID	OD Mov	Demand Total	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h	
North: Bibra Dr (N)												
7	L2	206	5.0	0.224	5.2	LOS A	1.0	7.4	0.46	0.57	55.3	
9a	R1	624	5.0	0.479	9.9	LOS A	2.9	21.4	0.52	0.69	53.1	
Approach		829	5.0	0.479	8.7	LOS A	2.9	21.4	0.50	0.66	53.6	
SouthWest: Bibra Drive (SW)												
30a	L1	654	2.0	0.337	2.6	LOS A	0.0	0.0	0.00	0.29	59.5	
32a	R1	350	2.0	0.224	8.2	LOS A	0.0	0.0	0.00	0.61	55.3	
Approach		1004	2.0	0.337	4.5	LOS A	0.0	0.0	0.00	0.40	57.9	
All Vehicles		1833	3.4	0.479	6.4	LOS A	2.9	21.4	0.23	0.52	55.9	

## 2021 PM

Movement Performance - Vehicles												
Mov ID	OD Mov	Demand Total	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h	
North: Bibra Dr (N)												
7	L2	464	5.0	0.403	3.9	LOS A	2.2	16.0	0.29	0.44	56.0	
9a	R1	1348	5.0	0.847	9.4	LOS A	12.4	90.8	0.56	0.56	53.0	
Approach		1812	5.0	0.847	8.0	LOS A	12.4	90.8	0.49	0.53	53.7	
SouthWest: Bibra Drive (SW)												
30a	L1	625	2.0	0.322	2.6	LOS A	0.0	0.0	0.00	0.29	59.5	
32a	R1	100	2.0	0.068	8.2	LOS A	0.0	0.0	0.00	0.61	55.3	
Approach		724	2.0	0.322	3.3	LOS A	0.0	0.0	0.00	0.33	58.9	
All Vehicles		2536	4.1	0.847	6.6	LOS A	12.4	90.8	0.35	0.47	55.1	

**2031 AM**

Movement Performance - Vehicles												
Mov ID	OD Mov	Demand Total	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h	
North: Bibra Dr (N)												
7	L2	246	5.0	0.285	5.9	LOS A	1.4	10.0	0.54	0.64	54.9	
9a	R1	741	5.0	0.603	11.6	LOS B	5.0	36.5	0.66	0.80	52.6	
Approach		987	5.0	0.603	10.2	LOS B	5.0	36.5	0.63	0.76	53.1	
SouthWest: Bibra Drive (SW)												
30a	L1	721	2.0	0.371	2.6	LOS A	0.0	0.0	0.00	0.29	59.5	
32a	R1	455	2.0	0.289	8.2	LOS A	0.0	0.0	0.00	0.61	55.3	
Approach		1176	2.0	0.371	4.7	LOS A	0.0	0.0	0.00	0.41	57.8	
All Vehicles		2162	3.4	0.603	7.2	LOS A	5.0	36.5	0.29	0.57	55.6	

**2031 PM**

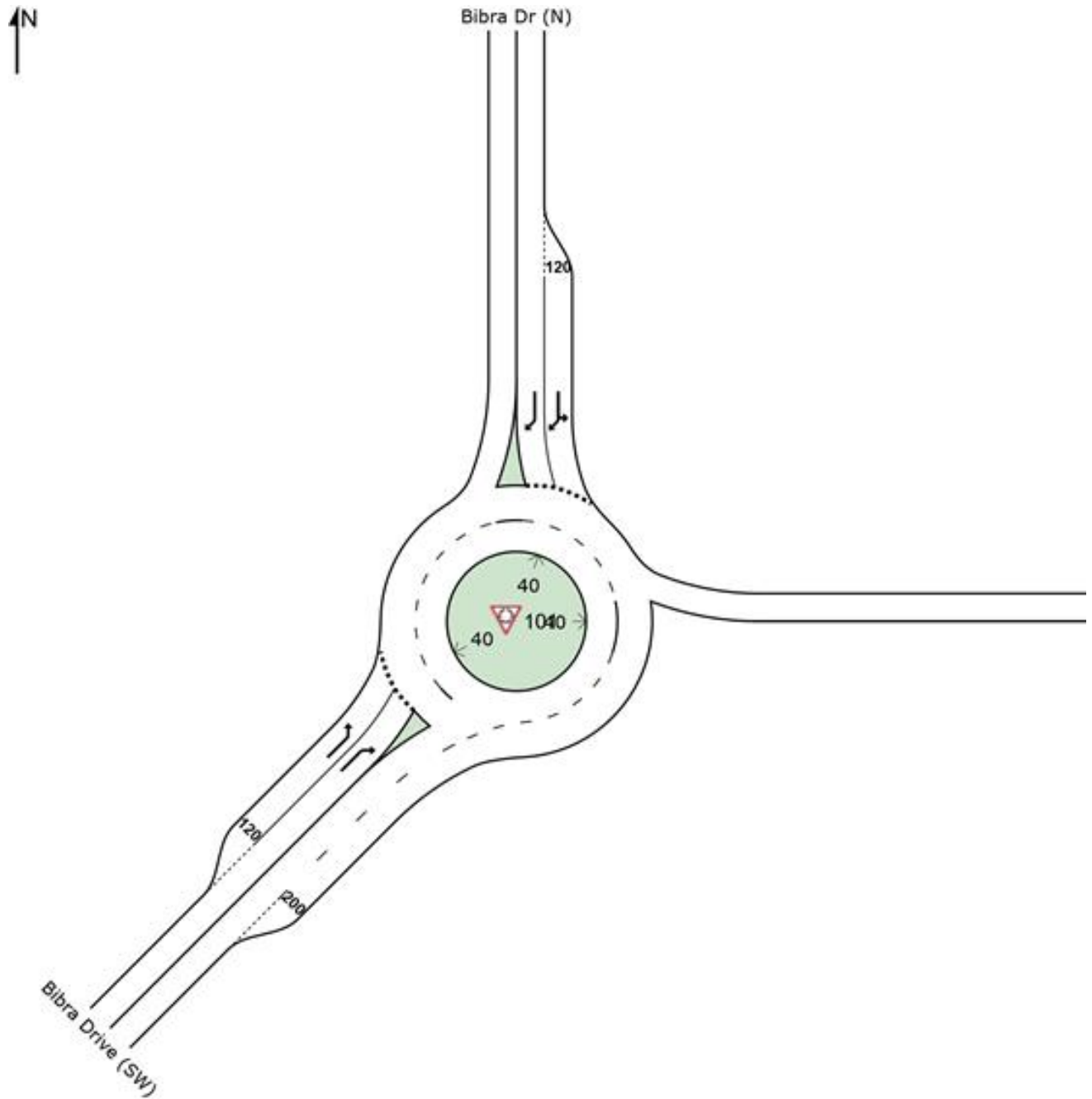
Movement Performance - Vehicles												
Mov ID	OD Mov	Demand Total	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h	
North: Bibra Dr (N)												
7	L2	555	5.0	0.515	4.6	LOS A	3.2	23.3	0.44	0.52	55.3	
9a	R1	1601	5.0	1.065	248.6	LOS F	281.4	2054.1	1.00	5.13	12.5	
Approach		2155	5.0	1.065	185.8	LOS F	281.4	2054.1	0.86	3.94	15.4	
SouthWest: Bibra Drive (SW)												
30a	L1	674	2.0	0.347	2.6	LOS A	0.0	0.0	0.00	0.29	59.5	
32a	R1	174	2.0	0.118	8.2	LOS A	0.0	0.0	0.00	0.61	55.3	
Approach		848	2.0	0.347	3.7	LOS A	0.0	0.0	0.00	0.35	58.6	
All Vehicles		3003	4.2	1.065	134.4	LOS F	281.4	2054.1	0.61	2.93	19.4	

Findings

For the Bibra Drive / Hope Road roundabout, the analysis shows that this will operate with acceptable LOS for the 2021 scenarios, noting that the eastern approach is operating with higher-than-desired Degree of Saturation (DOS) for the 2021 PM scenario. However, for the 2031 PM scenario, the forecast growth in southbound traffic on Bibra Drive will not provide sufficient gaps in traffic for the eastern approach, resulting in queue lengths extending back to Roe Highway and a LOS of F.

Noting the low level of service provided by the current MRWA design, Cardno undertook further analysis on the Bibra Drive / Murdoch Drive Connection roundabout factoring improvements for the southbound approach and exit. This is represented graphically in the Sidra layout below.

### Roundabout 2 - Bibra Drive / Murdoch Drive Connection (Cardno Amended Geometric Design)



**SIDRA Layout – Cardno Amended Roundabout Configuration**



## 2021 AM

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Total	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
North: Bibra Dr (N)											
7	L2	206	5.0	0.345	4.7	LOS A	1.8	13.5	0.46	0.62	53.4
9a	R1	624	5.0	0.345	9.8	LOS A	1.8	13.5	0.47	0.66	54.0
Approach		829	5.0	0.345	8.5	LOS A	1.8	13.5	0.47	0.65	53.9
SouthWest: Bibra Drive (SW)											
30a	L1	654	2.0	0.358	2.6	LOS A	0.0	0.0	0.00	0.29	59.5
32a	R1	350	2.0	0.235	8.2	LOS A	0.0	0.0	0.00	0.61	55.3
Approach		1004	2.0	0.358	4.5	LOS A	0.0	0.0	0.00	0.40	57.9
All Vehicles		1833	3.4	0.358	6.3	LOS A	1.8	13.5	0.21	0.51	56.0

## 2021 PM

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Total	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
North: Bibra Dr (N)											
7	L2	464	5.0	0.616	3.8	LOS A	4.6	33.9	0.33	0.52	53.9
9a	R1	1348	5.0	0.616	8.9	LOS A	4.7	34.3	0.35	0.56	54.5
Approach		1812	5.0	0.616	7.6	LOS A	4.7	34.3	0.35	0.55	54.3
SouthWest: Bibra Drive (SW)											
30a	L1	625	2.0	0.342	2.6	LOS A	0.0	0.0	0.00	0.29	59.5
32a	R1	100	2.0	0.075	8.2	LOS A	0.0	0.0	0.00	0.61	55.3
Approach		724	2.0	0.342	3.3	LOS A	0.0	0.0	0.00	0.33	58.9
All Vehicles		2536	4.1	0.616	6.4	LOS A	4.7	34.3	0.25	0.49	55.5

**2031 AM**

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
North: Bibra Dr (N)											
7	L2	246	5.0	0.437	5.4	LOS A	2.6	19.0	0.57	0.69	53.0
9a	R1	741	5.0	0.437	10.6	LOS B	2.6	19.0	0.58	0.73	53.6
Approach		987	5.0	0.437	9.3	LOS A	2.6	19.0	0.57	0.72	53.5
SouthWest: Bibra Drive (SW)											
30a	L1	721	2.0	0.395	2.6	LOS A	0.0	0.0	0.00	0.29	59.5
32a	R1	455	2.0	0.301	8.2	LOS A	0.0	0.0	0.00	0.61	55.3
Approach		1176	2.0	0.395	4.7	LOS A	0.0	0.0	0.00	0.41	57.8
All Vehicles		2162	3.4	0.437	6.8	LOS A	2.6	19.0	0.26	0.55	55.7

**2031 PM**

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
North: Bibra Dr (N)											
7	L2	555	5.0	0.776	4.7	LOS A	8.0	58.4	0.59	0.59	53.0
9a	R1	1601	5.0	0.776	10.2	LOS B	8.7	63.2	0.62	0.64	53.4
Approach		2155	5.0	0.776	8.8	LOS A	8.7	63.2	0.61	0.62	53.3
SouthWest: Bibra Drive (SW)											
30a	L1	674	2.0	0.347	2.6	LOS A	0.0	0.0	0.00	0.29	59.5
32a	R1	174	2.0	0.118	8.2	LOS A	0.0	0.0	0.00	0.61	55.3
Approach		848	2.0	0.347	3.7	LOS A	0.0	0.0	0.00	0.35	58.6
All Vehicles		3003	4.2	0.776	7.4	LOS A	8.7	63.2	0.44	0.55	54.7

Findings

The proposed improved design for the southbound approach and exit has resulted in an overall satisfactory performance.

### ROM data Commentary Option 4

From a review of the calibration plots provided by MRWA there is substantially higher modelled traffic volumes on Bibra Drive compared to observed, with opposite scenario occurring for Farrington Road.

This is resulting in a substantial volume of traffic using Bibra Drive as a north-south connection between Farrington Road and North Lake Road.

Depending on how the link flow capacities for the different link types as set up in ROM, MRWA could potentially address this observed discrepancy by 'downgrading' Bibra Drive, in ROM, to a lower order road or by reducing the capacity of Bibra Drive (such that it attracts less traffic). This will like balance traffic between Farrington Road and Bibra Drive to volumes closer to those seen in traffic counts and will assist with some of the issues identified in the future year models which indicate 20,000 – 26,000 vehicles per day on Bibra Drive, which is not considered realistic.

Study Area Road Hierarchy (source: MRWA)

