Cal-B/C Training Module 9a.2

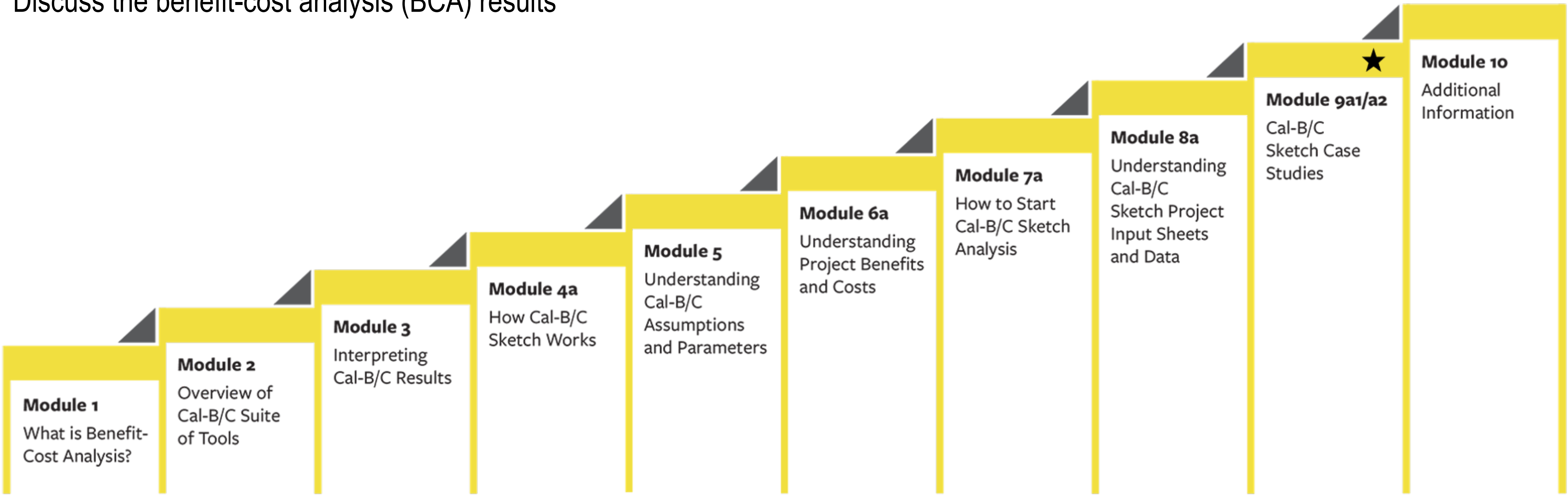
Cal-B/C Sketch HOV Case Study

01

About This Module

This module will…

- Walk you through a hypothetical High-Occupancy Vehicle (HOV) lane construction project
- Provide details on where to get data to input into the example
- Discuss the benefit-cost analysis (BCA) results



★ *This module is covered in this presentation*

Previous Modules…

- Module 1 provided a basic introduction on benefit-cost analysis (BCA) and a general overview of how to conduct a BCA
- Module 2 described the Cal-B/C suite of tools, discussed the types of projects that can be evaluated, and provided guidance on which tools to use for various project types
- Module 3 presented the Cal-B/C results page, detailed what each output measure means, and explained how they are calculated
- Module 4a presented an overview of how Cal-B/C Sketch works including a review of all worksheets and inputs
  - This current module complements Module 4a
- Module 5 highlighted the information in the Parameters worksheet and discussed key assumptions used by Cal-B/C
- Module 6a provided detailed information on how Cal-B/C Sketch calculates benefits
- Module 7a presented the 1-2-3 approach to starting a Cal-B/C Sketch analysis
  - This current module complements Module 7a
- Module 8a discussed potential data sources that can be used in a Cal-B/C Sketch analysis

02

Project Information Worksheet

HOV Lane Project Description

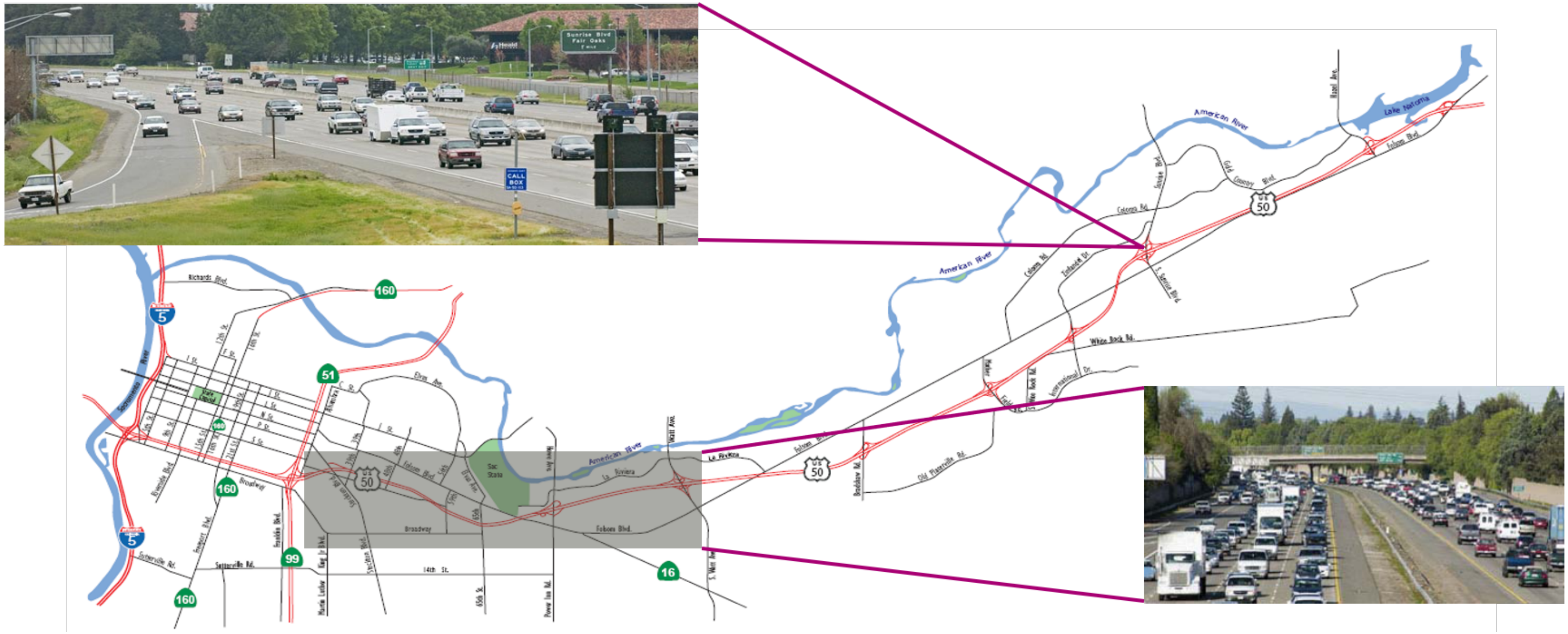
Constructing hypothetical HOV lanes in Northern California

No Build Case:

- 8 general purpose lanes

Build Case:

- 8 general purpose lanes plus 2 HOV lanes



Project Information

1

1) Project Information Worksheet Overview (from Module 4a)

- The primary data entry worksheet for Cal-B/C Sketch
- Other worksheets should be modified if project specific information is available

1A Project Data

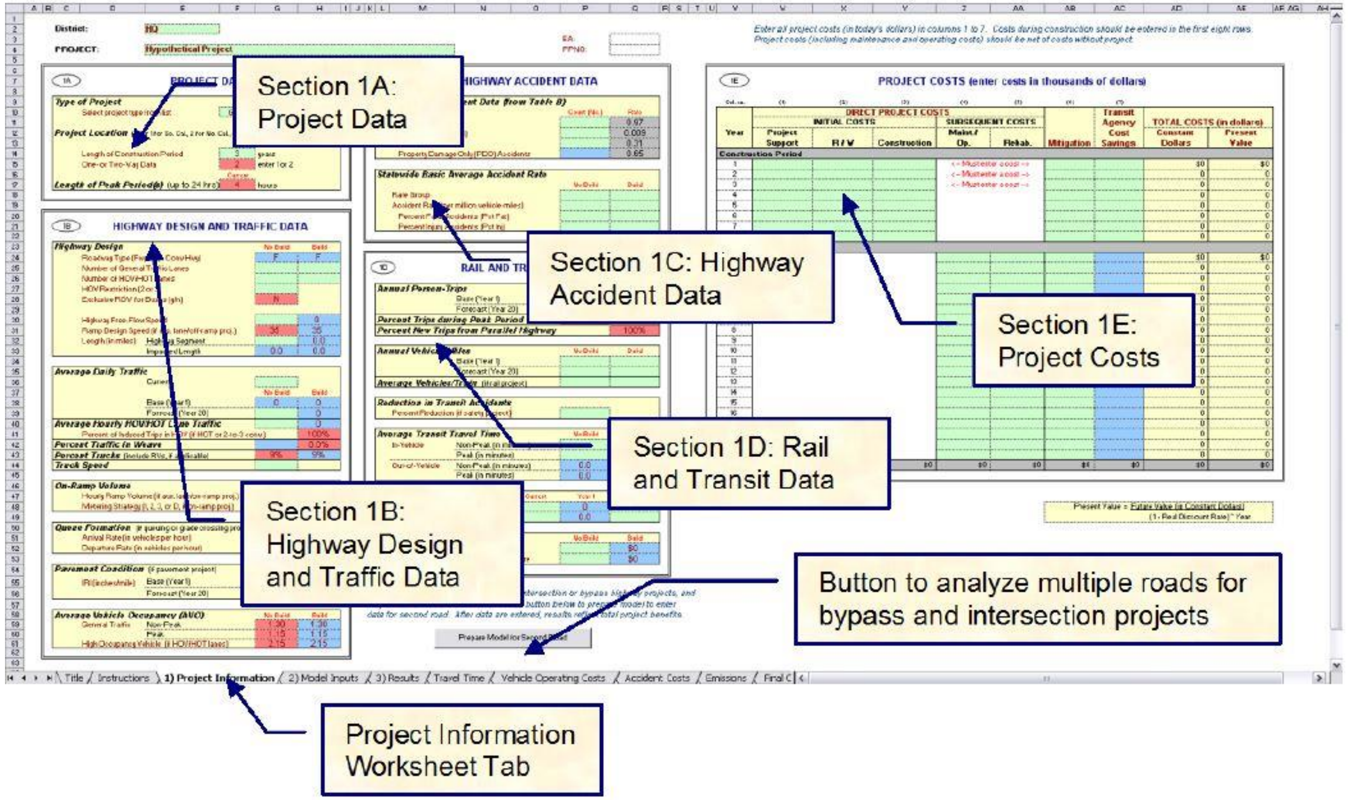
- Required for all projects

1B Highway Design and Traffic Data

- Required data for roadway geometrics, traffic demand, and speed data
- Data such as average vehicle occupancy (AVO) can be obtained from public sources
- On-ramp volume, queue length, and pavement condition sections do not need to be filled out

1C Highway Accident (i.e., Collision) Data

- Required data for roadway projects with expected safety benefits



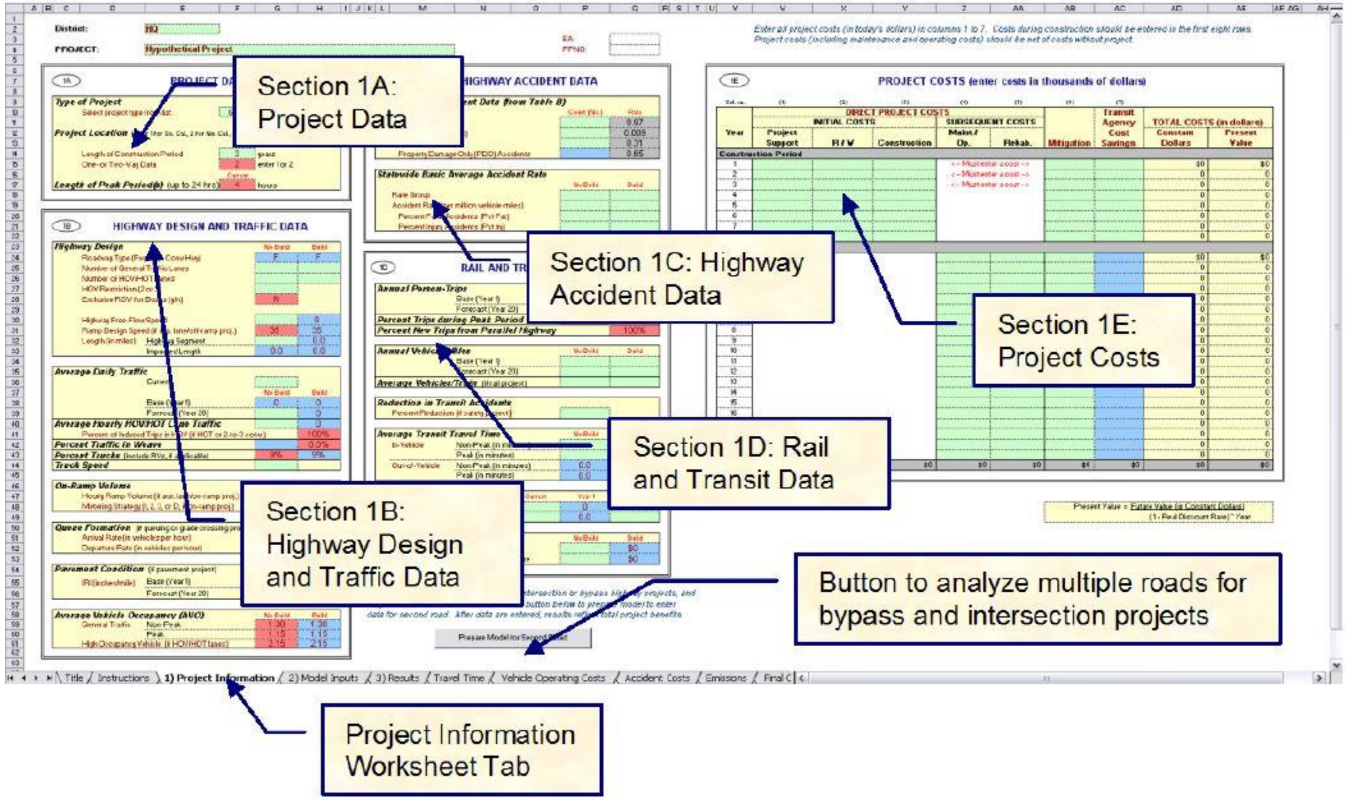
1) Project Information Worksheet Overview (from Module 4a)

1D Rail and Transit Data

- Not needed for an HOV lane project

1E Project Costs

- Required to fill in for each year of construction period
- Recommended to estimate O&M costs based on existing relevant highway expansion projects. O&M costs should be the difference between the No Build and Build Scenarios.



1A) Enter Project Data

District:	HQ
PROJECT:	Hypothetical HOV Lane in Northern California

1A **PROJECT DATA**

Type of Project	Enter HOV restriction in section 1B	
Select project type from list	HOV Lane Addition	
Project Location (enter 1 for So. Cal., 2 for No. Cal., or 3 for rural)	2	
Length of Construction Period	3	years
One- or Two-Way Data	2	enter 1 or 2
	Current	
Length of Peak Period(s) (up to 24 hrs)	6	hours

Project Data Information:

- HOV Lane Addition
- Located in Northern California
- Construction Period of 3 years
- Two-Way Data
- Average weekday peak periods total 6 hours

Type of Project

- Select **"HOV Lane Addition"** in pull-down menu

Project Location

- Enter **"2"** for Northern California

Length of Construction Period

- Enter **"3"** for an estimated 3 years of construction

One- or Two-Way Data

- Enter **"2"** to indicate that the average daily traffic (ADT) data represents two directions of the corridor

Length of Peak Period(s)

- Enter **"6"** for total peak period hours (e.g., 3 hours in the AM and 3 hours in the PM)

Input Project Identifier Data (optional):

- Input unique project identifiers (optional): Caltrans District, Project Name including the freeway exit name or corridor name and from postmile to postmiles, Expenditure Authorization (EA) number, and Planning and Programming Number (PPNO)

1B) Enter Highway Design and Traffic Data

Roadway Type

- Enter **“F”** (freeway)

Number of General Traffic Lanes

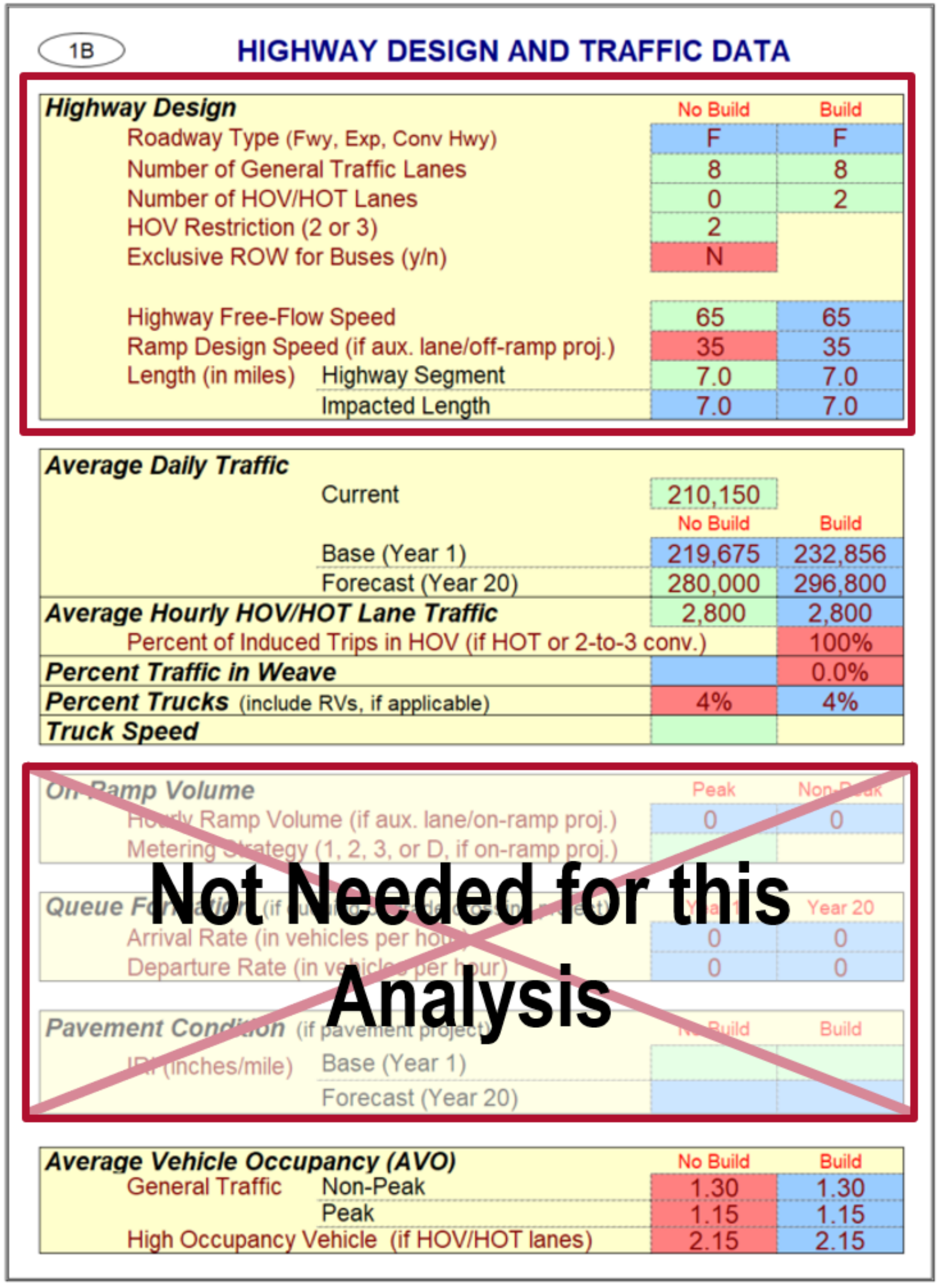
- Enter **“8”** for the No Build and Build scenarios because the number of general traffic lanes will not change

Number of HOV/HOT Lanes

- Enter **“0”** for the No Build and **“2”** for the Build scenario because the project will add two HOV lanes

HOV Restriction (2 or 3)

- Enter **“2”** indicating that the HOV lanes will require 2 or more people per vehicle


1B HIGHWAY DESIGN AND TRAFFIC DATA

Highway Design		No Build	Build
Roadway Type (Fwy, Exp, Conv Hwy)		F	F
Number of General Traffic Lanes		8	8
Number of HOV/HOT Lanes		0	2
HOV Restriction (2 or 3)		2	
Exclusive ROW for Buses (y/n)		N	
Highway Free-Flow Speed		65	65
Ramp Design Speed (if aux. lane/off-ramp proj.)		35	35
Length (in miles)	Highway Segment	7.0	7.0
	Impacted Length	7.0	7.0

Average Daily Traffic		No Build	Build
	Current	210,150	
	Base (Year 1)	219,675	232,856
	Forecast (Year 20)	280,000	296,800
Average Hourly HOV/HOT Lane Traffic		2,800	2,800
Percent of Induced Trips in HOV (if HOT or 2-to-3 conv.)			100%
Percent Traffic in Weave			0.0%
Percent Trucks (include RVs, if applicable)		4%	4%
Truck Speed			

Not Needed for this Analysis

On-Ramp Volume		Peak	Non-Peak
Hourly Ramp Volume (if aux. lane/on-ramp proj.)		0	0
Metering Strategy (1, 2, 3, or D, if on-ramp proj.)			
Queue Formation		Year 1	Year 20
Arrival Rate (in vehicles per hour)		0	0
Departure Rate (in vehicles per hour)		0	0
Pavement Condition (if pavement project)		No Build	Build
IRI (inches/mile)	Base (Year 1)		
	Forecast (Year 20)		

Average Vehicle Occupancy (AVO)		No Build	Build
General Traffic	Non-Peak	1.30	1.30
	Peak	1.15	1.15
High Occupancy Vehicle (if HOV/HOT lanes)		2.15	2.15

1B) Enter Highway Design and Traffic Data

Exclusive ROW (Right-of-Way) for Buses

- Default value of **"N"**, as this HOV facility will not provide exclusive bus only lanes

Highway Free-Flow Speed

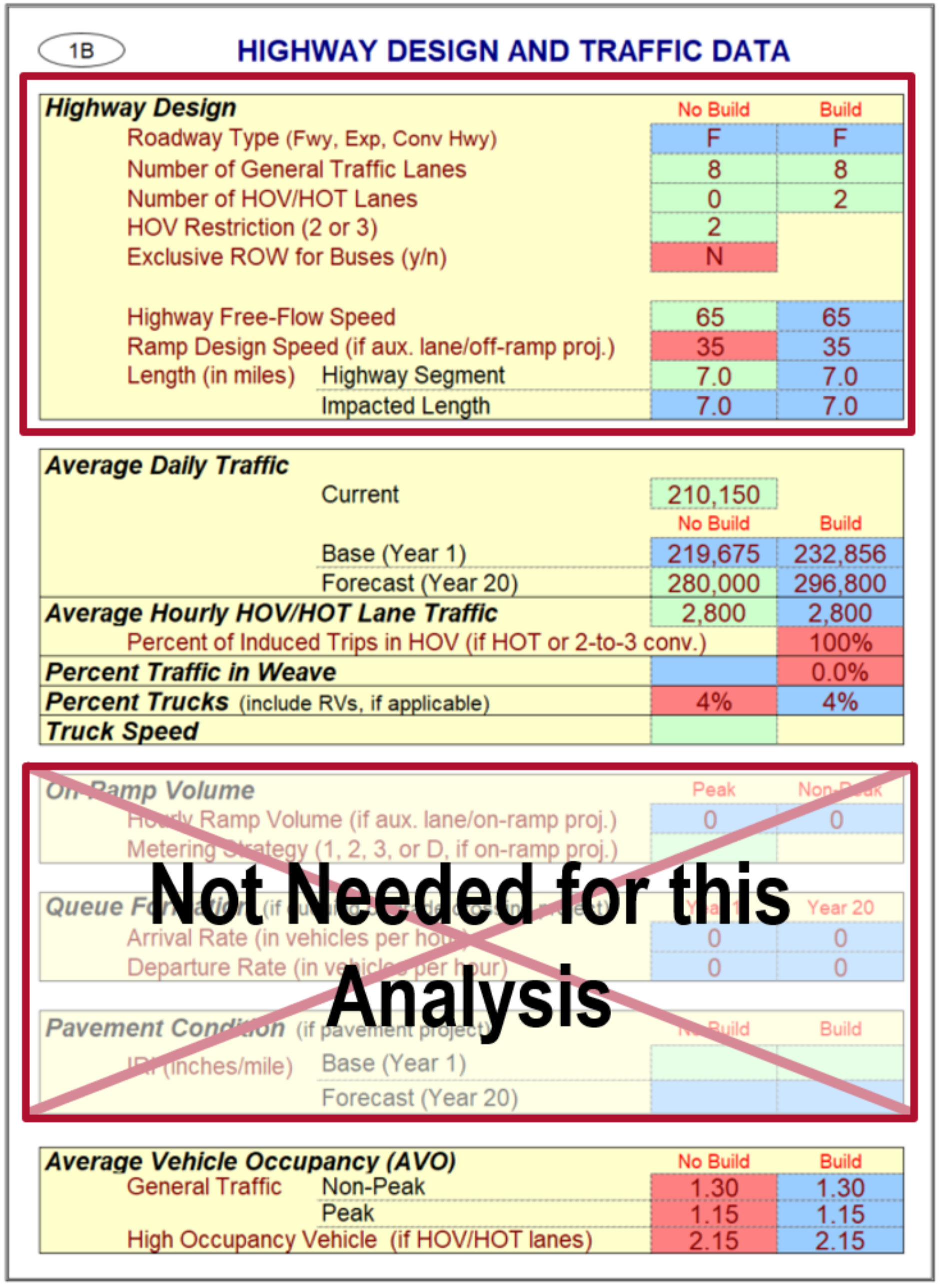
- Input **"65"** for the design speed for this urban highway since the posted speed is 65 mph and the design speed is assumed to be the same

Ramp Design Speed (if auxiliary lane/off-ramp project)

- This is not needed for the analysis, so keep the default ramp speed

Length

- Input **"7"** for Highway Segment Length
- Cal-B/C Sketch will automatically assume that the Impacted Length is the same length as the Highway Segment. *Only change this input if the project will affect traffic in an area different (larger or smaller) than the Highway Segment.*



1B HIGHWAY DESIGN AND TRAFFIC DATA

Highway Design		No Build	Build
Roadway Type (Fwy, Exp, Conv Hwy)		F	F
Number of General Traffic Lanes		8	8
Number of HOV/HOT Lanes		0	2
HOV Restriction (2 or 3)		2	
Exclusive ROW for Buses (y/n)		N	
Highway Free-Flow Speed		65	65
Ramp Design Speed (if aux. lane/off-ramp proj.)		35	35
Length (in miles)	Highway Segment	7.0	7.0
	Impacted Length	7.0	7.0

Average Daily Traffic		No Build	Build
	Current	210,150	
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Percent of Induced Trips in HOV (if HOT or 2-to-3 conv.)			100%
Percent Traffic in Weave			0.0%
Percent Trucks (include RVs, if applicable)		4%	4%
Truck Speed			

Not Needed for this Analysis

On-Ramp Volume		Peak	Non-Peak
Hourly Ramp Volume (if aux. lane/on-ramp proj.)		0	0
Metering Strategy (1, 2, 3, or D, if on-ramp proj.)			
Queue Formation			Year 20
Arrival Rate (in vehicles per hour)		0	0
Departure Rate (in vehicles per hour)		0	0
Pavement Condition (if pavement project)		No Build	Build
IRI (inches/mile)	Base (Year 1)		
	Forecast (Year 20)		

Average Vehicle Occupancy (AVO)		No Build	Build
General Traffic	Non-Peak	1.30	1.30
	Peak	1.15	1.15
High Occupancy Vehicle (if HOV/HOT lanes)		2.15	2.15

1B) Enter Highway Design and Traffic Data

Average Daily Traffic (ADT)

- Current: Enter **“210,150”** for general purpose highway ADT
  - In 1A), you entered a “2” to indicate that the ADT represents two-way traffic
- Forecast: Enter **“280,000”** for estimated ADT 20 years after the project opening date (opening year + 20) in the No Build scenario
  - This represents a growth rate of around 1.3% per year
  - Cal-B/C estimates Base (Year 1) volume for the No Build scenario
  - Cal-B/C can estimate both Base (Year 1) and Forecast (Year 20) traffic in the Build scenario
  - The formulas do not estimate any induced demand.
- Overwrite the Build traffic estimates, assuming that the project induces a 6% increase in traffic in the Base and Forecast years
  - Enter the values shown or formulas to calculate the Build traffic in each year

Average Daily Traffic			
	Current	210,150	
		No Build	Build
	Base (Year 1)	219,675	232,856
	Forecast (Year 20)	280,000	296,800
Average Hourly HOV/HOT Lane Traffic		2,800	2,800
Percent of Induced Trips in HOV (if HOT or 2-to-3 conv.)			100%
Percent Traffic in Weave			0.0%
Percent Trucks (include RVs, if applicable)		4%	4%
Truck Speed			

Not Needed for this Analysis

On-Ramp Volume		Peak	Non-Peak
Hourly Ramp Volume (if aux. lane/on-ramp proj.)		0	0
Metering Strategy (1, 2, 3, or D, if on-ramp proj.)			
Queue Formation (if [illegible])		Year 1	Year 20
Arrival Rate (in vehicles per hour)		0	0
Departure Rate (in vehicles per hour)		0	0
Pavement Condition (if pavement project)		No Build	Build
IRI (inches/mile)	Base (Year 1)		
	Forecast (Year 20)		

Average Vehicle Occupancy (AVO)		No Build	Build
General Traffic	Non-Peak	1.30	1.30
	Peak	1.15	1.15
High Occupancy Vehicle (if HOV/HOT lanes)		2.15	2.15

1B) Enter Highway Design and Traffic Data

Average Hourly HOV/HOT Lane Traffic

- Enter **"2,800"** for in the No Build (representing the demand for HOV lanes in the No Build)
- Enter **"2,800"** for the HOV lane traffic in the Build scenario

Percent of Induced Trips in HOV (if HOT or 2-3 conversion)

- Keep the **"100%"** default value

Average Daily Traffic			
	Current	210,150	
		No Build	Build
	Base (Year 1)	219,675	232,856
	Forecast (Year 20)	280,000	296,800
Average Hourly HOV/HOT Lane Traffic		2,800	2,800
	Percent of Induced Trips in HOV (if HOT or 2-to-3 conv.)		100%
Percent Traffic in Weave			0.0%
Percent Trucks (include RVs, if applicable)		4%	4%
Truck Speed			

Not Needed for this Analysis

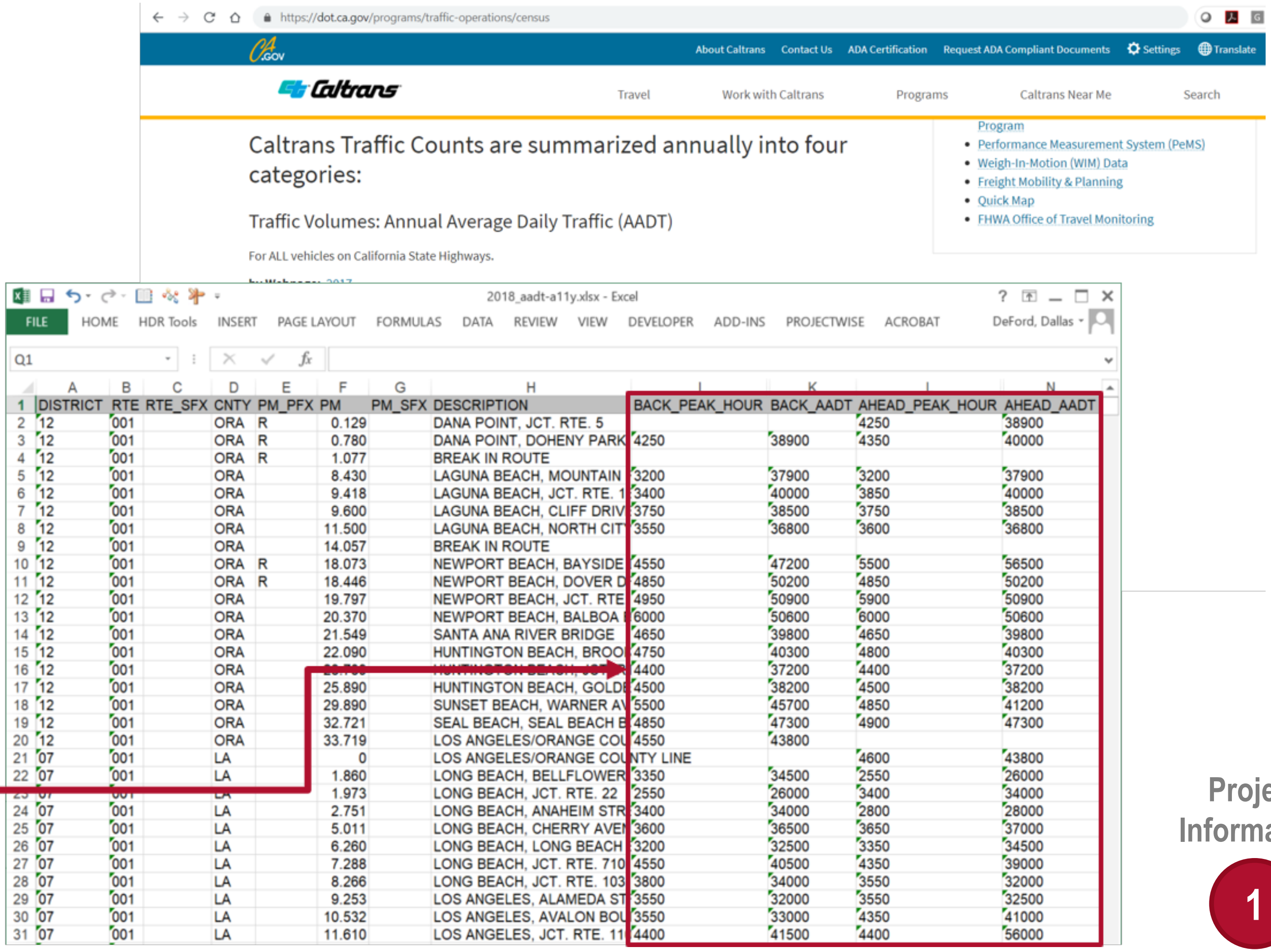
~~*On-Ramp Volume*~~		~~Peak~~	~~Non-Peak~~
	~~Hourly Ramp Volume (if aux. lane/on-ramp proj.)~~	~~0~~	~~0~~
	~~Metering Strategy (1, 2, 3, or D, if on-ramp proj.)~~		
~~*Queue Formation*~~		~~Year 1~~	~~Year 20~~
	~~Arrival Rate (in vehicles per hour)~~	~~0~~	~~0~~
	~~Departure Rate (in vehicles per hour)~~	~~0~~	~~0~~
~~*Pavement Condition* (if pavement project)~~		~~No Build~~	~~Build~~
~~IRI (inches/mile)~~	~~Base (Year 1)~~		
	~~Forecast (Year 20)~~		

Average Vehicle Occupancy (AVO)		No Build	Build
General Traffic	Non-Peak	1.30	1.30
	Peak	1.15	1.15
High Occupancy Vehicle (if HOV/HOT lanes)		2.15	2.15

1B) Highway Design and Traffic Data – Where to Find Traffic Data?

Data Sources

- Caltrans Traffic Census Program website https://dot.ca.gov/programs/traffic-operations/census
- Annual Average Daily Traffic by segment
  - Calculate a weighted average volume by distance OR
  - Calculate a uniform average volume (based on the corridor segments and count location characteristics)



	DISTRICT	RTE	RTE_SFX	CNTY	PM_PFX	PM	PM_SFX	DESCRIPTION	BACK_PEAK_HOUR	BACK_AADT	AHEAD_PEAK_HOUR	AHEAD_AADT
2	12	001		ORA	R	0.129		DANA POINT, JCT. RTE. 5			4250	38900
3	12	001		ORA	R	0.780		DANA POINT, DOHENY PARK	4250	38900	4350	40000
4	12	001		ORA	R	1.077		BREAK IN ROUTE				
5	12	001		ORA		8.430		LAGUNA BEACH, MOUNTAIN	3200	37900	3200	37900
6	12	001		ORA		9.418		LAGUNA BEACH, JCT. RTE. 1	3400	40000	3850	40000
7	12	001		ORA		9.600		LAGUNA BEACH, CLIFF DRIV	3750	38500	3750	38500
8	12	001		ORA		11.500		LAGUNA BEACH, NORTH CIT	3550	36800	3600	36800
9	12	001		ORA		14.057		BREAK IN ROUTE				
10	12	001		ORA	R	18.073		NEWPORT BEACH, BAYSIDE	4550	47200	5500	56500
11	12	001		ORA	R	18.446		NEWPORT BEACH, DOVER D	4850	50200	4850	50200
12	12	001		ORA		19.797		NEWPORT BEACH, JCT. RTE	4950	50900	5900	50900
13	12	001		ORA		20.370		NEWPORT BEACH, BALBOA	6000	50600	6000	50600
14	12	001		ORA		21.549		SANTA ANA RIVER BRIDGE	4650	39800	4650	39800
15	12	001		ORA		22.090		HUNTINGTON BEACH, BROO	4750	40300	4800	40300
16	12	001		ORA		[illegible]		[illegible]	4400	37200	4400	37200
17	12	001		ORA		25.890		HUNTINGTON BEACH, GOLD	4500	38200	4500	38200
18	12	001		ORA		29.890		SUNSET BEACH, WARNER A	5500	45700	4850	41200
19	12	001		ORA		32.721		SEAL BEACH, SEAL BEACH B	4850	47300	4900	47300
20	12	001		ORA		33.719		LOS ANGELES/ORANGE COU	4550	43800		
21	07	001		LA		0		LOS ANGELES/ORANGE COUNTY LINE			4600	43800
22	07	001		LA		1.860		LONG BEACH, BELLFLOWER	3350	34500	2550	26000
23	07	001		LA		1.973		LONG BEACH, JCT. RTE. 22	2550	26000	3400	34000
24	07	001		LA		2.751		LONG BEACH, ANAHEIM STR	3400	34000	2800	28000
25	07	001		LA		5.011		LONG BEACH, CHERRY AVE	3600	36500	3650	37000
26	07	001		LA		6.260		LONG BEACH, LONG BEACH	3200	32500	3350	34500
27	07	001		LA		7.288		LONG BEACH, JCT. RTE. 710	4550	40500	4350	39000
28	07	001		LA		8.266		LONG BEACH, JCT. RTE. 103	3800	34000	3550	32000
29	07	001		LA		9.253		LOS ANGELES, ALAMEDA ST	3550	32000	3550	32500
30	07	001		LA		10.532		LOS ANGELES, AVALON BOU	3550	33000	4350	41000
31	07	001		LA		11.610		LOS ANGELES, JCT. RTE. 11	4400	41500	4400	56000

Project Information

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1B) Highway Design and Traffic Data – Average Vehicle Occupancy

Percent Traffic in Weave

- Do nothing. Project is not an operational improvement; data entry will not affect the analysis.

Percent Trucks

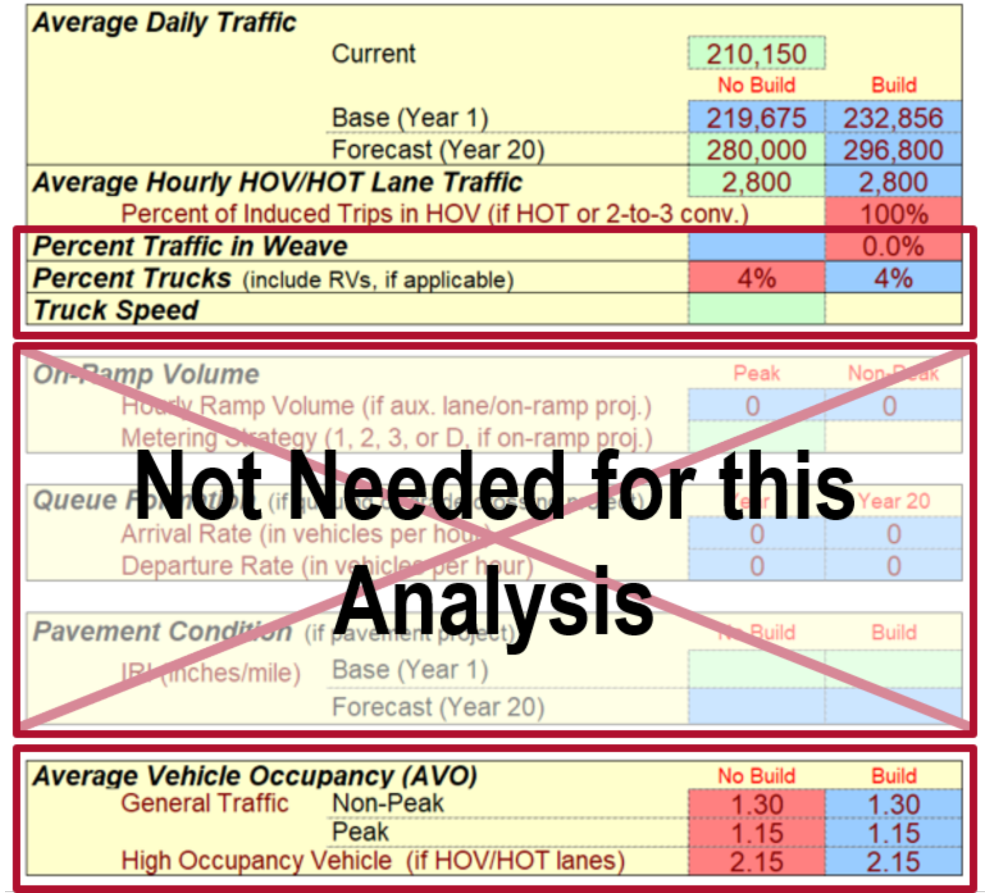
- Enter **“4%”** for percentage of trucks on highway segment (see next slide)

Truck Speed

- Leave blank since this is not a passing lane project

Average Vehicle Occupancy (AVO)

- Keep the default values for this analysis
- AVO data can be obtained from several sources including:
    - Caltrans Managed Lanes Annual Reports
    - Regional Travel Demand Models
    - U.S. Census American Community Survey Data (at county level)
    - Field data collection – vehicle classification and occupancy counts



Project Information

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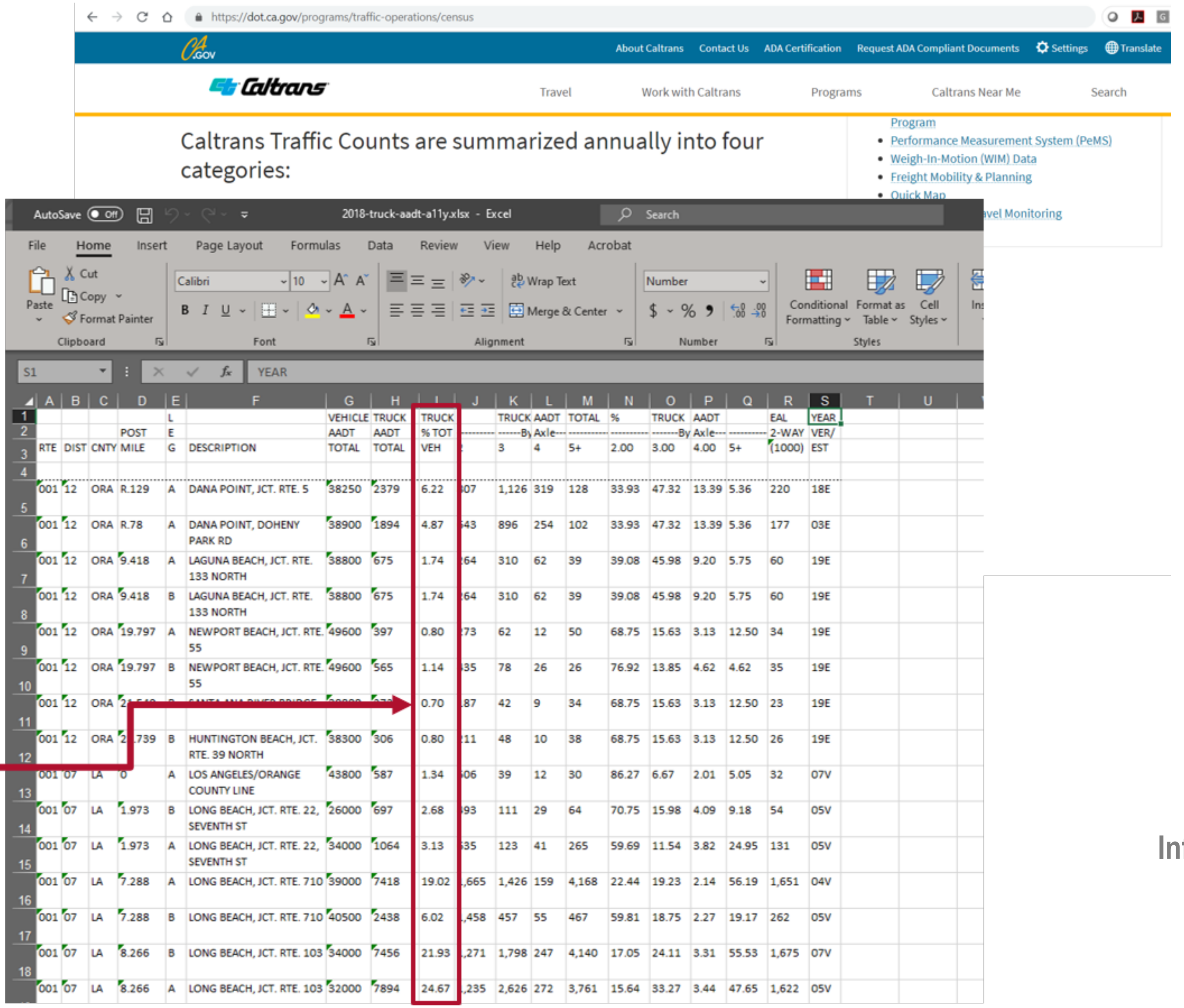
1B) Highway Design and Traffic Data – Where to Find Percent Trucks?

Data Sources

- Caltrans Traffic Census Program website https://dot.ca.gov/programs/traffic-operations/census
- Annual Average Daily Truck Traffic
  - Calculate a weighted average percentage by distance or volume
    OR
  - Calculate a uniform average percentage (based on the corridor segments and count location characteristics)

Truck % of total AADT by location



RTE	DIST	CNTY	POST MILE	LEG	DESCRIPTION	VEHICLE AADT TOTAL	TRUCK AADT TOTAL	TRUCK % TOT VEH		TRUCK AADT ------By Axle--- 3	4	TOTAL 5+	% 2.00	TRUCK AADT -------By Axle--- 3.00	4.00	5+	EAL 2-WAY (1000)	YEAR VER/ EST
001	12	ORA	R.129	A	DANA POINT, JCT. RTE. 5	38250	2379	6.22	07	1,126	319	128	33.93	47.32	13.39	5.36	220	18E
001	12	ORA	R.78	A	DANA POINT, DOHENY PARK RD	38900	1894	4.87	43	896	254	102	33.93	47.32	13.39	5.36	177	03E
001	12	ORA	9.418	A	LAGUNA BEACH, JCT. RTE. 133 NORTH	38800	675	1.74	64	310	62	39	39.08	45.98	9.20	5.75	60	19E
001	12	ORA	9.418	B	LAGUNA BEACH, JCT. RTE. 133 NORTH	38800	675	1.74	64	310	62	39	39.08	45.98	9.20	5.75	60	19E
001	12	ORA	19.797	A	NEWPORT BEACH, JCT. RTE. 55	49600	397	0.80	73	62	12	50	68.75	15.63	3.13	12.50	34	19E
001	12	ORA	19.797	B	NEWPORT BEACH, JCT. RTE. 55	49600	565	1.14	35	78	26	26	76.92	13.85	4.62	4.62	35	19E
001	12	ORA	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.70	87	42	9	34	68.75	15.63	3.13	12.50	23	19E
001	12	ORA	2[illegible].739	B	HUNTINGTON BEACH, JCT. RTE. 39 NORTH	38300	306	0.80	11	48	10	38	68.75	15.63	3.13	12.50	26	19E
001	07	LA	0	A	LOS ANGELES/ORANGE COUNTY LINE	43800	587	1.34	06	39	12	30	86.27	6.67	2.01	5.05	32	07V
001	07	LA	1.973	B	LONG BEACH, JCT. RTE. 22, SEVENTH ST	26000	697	2.68	93	111	29	64	70.75	15.98	4.09	9.18	54	05V
001	07	LA	1.973	A	LONG BEACH, JCT. RTE. 22, SEVENTH ST	34000	1064	3.13	35	123	41	265	59.69	11.54	3.82	24.95	131	05V
001	07	LA	7.288	A	LONG BEACH, JCT. RTE. 710	39000	7418	19.02	,665	1,426	159	4,168	22.44	19.23	2.14	56.19	1,651	04V
001	07	LA	7.288	B	LONG BEACH, JCT. RTE. 710	40500	2438	6.02	,458	457	55	467	59.81	18.75	2.27	19.17	262	05V
001	07	LA	8.266	B	LONG BEACH, JCT. RTE. 103	34000	7456	21.93	,271	1,798	247	4,140	17.05	24.11	3.31	55.53	1,675	07V
001	07	LA	8.266	A	LONG BEACH, JCT. RTE. 103	32000	7894	24.67	,235	2,626	272	3,761	15.64	33.27	3.44	47.65	1,622	05V

Project Information

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1C) Enter Highway Accident Data

Actual 3-Year Accident Data

- Total Accidents (Tot)
  - Enter **“4543”** for total accidents in the ‘Count (No.)’ cells
- Fatal Accidents (Fat)
  - Enter **“8”** for fatal accidents
- Injury Accidents (Inj)
  - Enter **“1262”** for injury accidents
- Property Damage Only (PDO) accidents are calculated = Tot – Fat – Inj

1C

HIGHWAY ACCIDENT DATA

Actual 3-Year Accident Data (from Table B)	Count (No.)	Rate
Total Accidents (Tot)	4543	2.82
Fatal Accidents (Fat)	8	0.005
Injury Accidents (Inj)	1262	0.78
Property Damage Only (PDO) Accidents	3273	2.03

Statewide Basic Average Accident Rate	No Build	Build
Rate Group	H 65	H 66
Accident Rate (per million vehicle-miles)	0.73	0.67
Percent Fatal Accidents (Pct Fat)	0.4%	0.3%
Percent Injury Accidents (Pct Inj)	31.7%	31.0%

1C) Enter Highway Accident Data

Statewide Basic Average Accident Rate

- Rate Group
  - Enter **"H 65"** for the 'No Build' and **"H 66"** for the 'Build' scenario
- Accident Rate (accidents per million vehicle-miles)
  - Enter **"0.73"** for the 'No Build' and **"0.67"** for the 'Build'
- Percent Fatal Accidents (Pct Fat)
  - Enter **"0.4%"** for the 'No Build' and **"0.3%"** for the 'Build'
- Percent Injury Accidents (Pct Inj)
  - Enter **"31.7%"** for the 'No Build' and **"31.0%"** for the 'Build'

1C

HIGHWAY ACCIDENT DATA

Actual 3-Year Accident Data (from Table B)	Count (No.)	Rate
Total Accidents (Tot)	4543	2.82
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Percent Fatal Accidents (Pct Fat)	0.4%	0.3%
Percent Injury Accidents (Pct Inj)	31.7%	31.0%

1C) Highway Accident Data – Where Did It Come From?

2017 Collision Data on California State Highways (road miles, travel, collisions, collision rates)

Caltrans

1C

HIGHWAY ACCIDENT DATA

Actual 3-Year Accident Data (from Table B)

	Count (No.)	Rate
Total Accidents (Tot)	4543	2.82
Fatal Accidents (Fat)	8	0.005
Injury Accidents (Inj)	1262	0.78
Property Damage Only (PDO) Accidents	3273	2.03

Statewide Basic Average Accident Rate

	No Build	Build
Rate Group	H 65	H 66
Accident Rate (per million vehicle-miles)	0.73	0.67
Percent Fatal Accidents (Pct Fat)	0.4%	0.3%
Percent Injury Accidents (Pct Inj)	31.7%	31.0%

4/7/2020

BASIC AVERAGE ACCIDENT RATE TABLE FOR HIGHWAYS

RATE GROUP	BASE RATE	+ ADT FACTOR	PCT FAT	PCT INJ	PCT F+I	HIGHWAY TYPE	TERRAIN OR ADT	DESIGN SPEED	AREA	ACC COSTS ($1,000) F+I	ALL
H 64	0.64	0.00200 *	0.5	32.1	32.6	FREEWAY 5-6 LANES; URBAN			URBAN	312.2	108.3
H 65	0.73	0.00100 *	0.4	31.7	32.1	FREEWAY 7-8 LANES; URBAN			URBAN	281.5	97.0
H 66	0.67	0.00100 *	0.3	31.0	31.3	FREEWAY 9-10 LANES; URBAN			URBAN	250.9	85.2
H 67	0.59	0.00200 *	0.3	30.2	30.5	FREEWAY 11 LANES OR MORE			URBAN	253.6	84.1

Caltrans, 2017 Collision Data on California State Highways, page 85.

Project Information

1

[Link to 2017 Collision Data on California State Highways]

Project Data Information:

- Capital Costs: $205,000,000 (2016$)

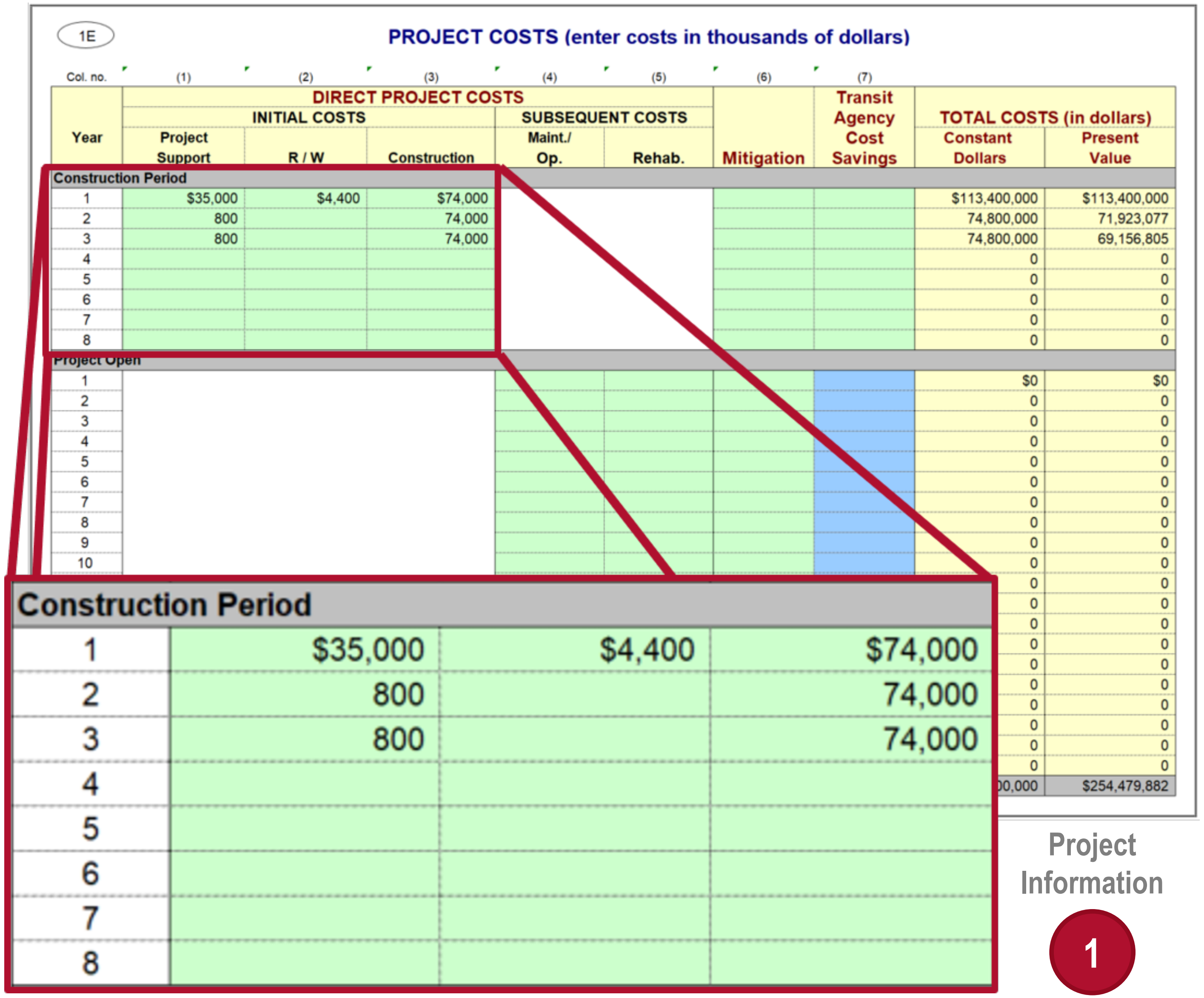
1E) Project Costs - Overview

Initial Costs

- Enter the initial project costs for project support, right-of-way (R/W), and construction as shown.
- Since the project is expected to take 3 years as indicated in Section 1A), 3 years of initial cost data must be entered.
- For projects in the preliminary planning phases, it is not necessary to input detailed cost data. For highway projects, it is likely that cost estimates are available from a PS&E or project study report.

Subsequent Costs

- In the preliminary planning phase, data to estimate an appropriate net change in O&M costs may not be available. For this hypothetical example, enter no subsequent costs.


1E

PROJECT COSTS (enter costs in thousands of dollars)

Col. no.	(1)	(2)	(3)	(4)	(5)	(6)	(7)		
	DIRECT PROJECT COSTS						Transit Agency Cost Savings	TOTAL COSTS (in dollars)	
	INITIAL COSTS			SUBSEQUENT COSTS					
Year	Project Support	R / W	Construction	Maint./ Op.	Rehab.	Mitigation		Constant Dollars	Present Value
Construction Period									
1	$35,000	$4,400	$74,000					$113,400,000	$113,400,000
2	800		74,000					74,800,000	71,923,077
3	800		74,000					74,800,000	69,156,805
4								0	0
5								0	0
6								0	0
7								0	0
8								0	0
Project Open									
1								$0	$0
2								0	0
3								0	0
4								0	0
5								0	0
6								0	0
7								0	0
8								0	0
9								0	0
10								0	0
								0	0
								0	0
								0	0
								0	0
								0	0
								0	0
								0	0
								0	0
								0	0
								0	0
								00,000	$254,479,882

Construction Period			
1	$35,000	$4,400	$74,000
2	800		74,000
3	800		74,000
4			
5			
6			
7			
8			

Project Information

1

03

Model Inputs Worksheet

2) Model Inputs Worksheet

- Review this worksheet to make sure that your volumes and speeds make sense (peak and non-peak, base and forecasted, no build and build).
- Year 1 speeds (the year after construction is completed) can be visually examined as a "reality check" on Cal-B/C calculations
- You can enter updated values in the green cells if better data is available

Does this peak period speed (current and forecasted) make sense for your corridor?

Year 1 is only a few years away (3 years after construction), so speeds calculated by Cal-B/C should likely reflect what you know to be the operating conditions on the roadway.

2A

HIGHWAY SPEED AND VOLUME INPUTS

	Calculated by Model	Changed by User	Used for Proj. Eval.	Reason for Change
No Build				
Year 1				
Peak Period				
HOV Volume	16,800		16,800	
Non-HOV Volume	83,161		83,161	
Weaving Volume	0		0	
Truck Volume	4,165		4,165	
HOV Speed	44.8		44.8	
Non-HOV Speed	44.8		44.8	
Weaving Speed	55.0		55.0	
Truck Speed	44.8		44.8	
Non-Peak Period				
Non-HOV Volume	110,927		110,927	
Weaving Volume	0		0	
Truck Volume	4,622		4,622	
Non-HOV Speed	65.0		65.0	
Weaving Speed	55.0		55.0	
Truck Speed	65.0		65.0	
Year 20				
Peak Period				
HOV Volume	16,800		16,800	
Non-HOV Volume	110,611		110,611	
Weaving Volume	0		0	
Truck Volume	5,309		5,309	
HOV Speed	10.7		10.7	
Non-HOV Speed	10.7		10.7	
Weaving Speed	55.0		55.0	
Truck Speed	10.7		10.7	
Non-Peak Period				
Non-HOV Volume	141,389		141,389	
Weaving Volume	0		0	
Truck Volume	5,891		5,891	
Non-HOV Speed	65.0		65.0	
Weaving Speed	55.0		55.0	
Truck Speed	65.0		65.0	

2) Model Inputs Worksheet

- This worksheet also lists the accident rates calculated for the project in the No Build and Build scenarios. Review to ensure that the rates make sense.
- No Build accident rates are calculated from the three-year accident count data entered in Section 1C
- Accident rates for the Build scenario are adjusted from No Build accident rates using the statewide average accident rates entered in Section 1C

2B

HIGHWAY ACCIDENT RATES

	Calculated by Model	Changed by User	Used for Proj. Eval.	Reason for Change
No Build				
Fatal Accidents	0.005		0.005	
Injury Accidents	0.78		0.78	
PDO Accidents	2.03		2.03	
Total Accidents	2.815			
Hwy Safety or Weaving Improvement		0%	collision reduction factor (per HSIP Guidelines)	
Adjustment Factor (Actual/Statewide Avg. Existing)				
Fatal Accidents	1.7123		1.7123	
Injury Accidents	3.3706		3.3706	
PDO Accidents	4.0955		4.0955	
Build				
Fatal Accidents	0.003		0.003	
Injury Accidents	0.70		0.70	
PDO Accidents	1.89		1.89	
Total Accidents	2.589			

Does this accident reduction make sense for the project improvements?

2) Model Inputs Worksheet

- Update the **Highway Accident Rates** in the **Build** scenario based on results from a hypothetical Safety Analysis
- In the green "Changed by User" column, enter **"0.004"** for Fatal Accidents, **"0.75"** for Injury Accidents, and **"1.95"** for PDO Accidents
  - The value in the corresponding gray cell in the "Used for Proj. Eval." column changes to match the user input.
- Include a reason for the change in the white "Reason for Change" column
  - Here, we enter "Based on Project Safety Analysis Report" to explain the changes.

2B

HIGHWAY ACCIDENT RATES

	Calculated by Model	Changed by User	Used for Proj. Eval.	Reason for Change
No Build				
Fatal Accidents	0.005		0.005	
Injury Accidents	0.78		0.78	
PDO Accidents	2.03		2.03	
Total Accidents	2.815			
Hwy Safety or Weaving Improvement		0%	collision reduction factor (per HSIP Guidelines)	
Adjustment Factor (Actual/Statewide Avg. Existing)				
Fatal Accidents	1.7123		1.7123	
Injury Accidents	3.3706		3.3706	
PDO Accidents	4.0955		4.0955	
Build				
Fatal Accidents	0.003	0.004	0.004	Based on Project Safety Analysis Report
Injury Accidents	0.70	0.75	0.75	Based on Project Safety Analysis Report
PDO Accidents	1.89	1.95	1.95	Based on Project Safety Analysis Report
Total Accidents	2.589			

04

Results Worksheet

3) Model Results

- This project has a relatively large, economically efficient **3.6** B/C ratio
- The payback period is **10** years
  - Number of years it takes for the net benefits (lifecycle benefits minus lifecycle costs) to equal the initial construction costs
- Most benefits are derived from travel time savings
- Accident cost savings are positive due to the estimated reduction in accident rates
- Vehicle operating cost savings are negative likely due to the increase in traffic and increase in speeds

3

INVESTMENT ANALYSIS

SUMMARY RESULTS

Life-Cycle Costs (mil. $)	$254.5
Life-Cycle Benefits (mil. $)	$903.5
Net Present Value (mil. $)	$649.1
Benefit / Cost Ratio:	3.6
Rate of Return on Investment:	13.6%
Payback Period:	10 years

ITEMIZED BENEFITS (mil. $)	Passenger Benefits	Freight Benefits	Total Over 20 Years	Average Annual
Travel Time Savings	$911.7	$56.7	$968.3	$48.4
Veh. Op. Cost Savings	-$102.2	-$7.8	-$110.0	-$5.5
Accident Cost Savings	$42.5	$1.8	$44.3	$2.2
Emission Cost Savings	$0.1	$0.8	$0.9	$0.0
TOTAL BENEFITS	$852.1	$51.4	$903.5	$45.2
Person-Hours of Time Saved			126,198,340	6,309,917

Should benefit-cost results include:

1) Induced Travel? (y/n)	Y	Default = Y
2) Vehicle Operating Costs? (y/n)	Y	Default = Y
3) Accident Costs? (y/n)	Y	Default = Y
4) Vehicle Emissions? (y/n) includes value for CO_2e	Y	Default = Y

EMISSIONS REDUCTION	Tons: Total Over 20 Years	Tons: Average Annual	Value (mil. $): Total Over 20 Years	Value (mil. $): Average Annual
CO Emissions Saved	137	7	$0.0	$0.0
CO_2 Emissions Saved	65,799	3,290	$0.8	$0.0
NO_X Emissions Saved	49	2	$0.1	$0.0
PM_{10} Emissions Saved	1	0	-$0.0	-$0.0
$PM_{2.5}$ Emissions Saved	1	0		
SO_X Emissions Saved	1	0	-$0.0	-$0.0
VOC Emissions Saved	28	1	$0.0	$0.0

3) Model Results

- Adjusting input variables can be done to test the sensitivity of these results
  - What happens if highway demand grows faster or slower than what was input?
  - What happens if the project induces more or less demand?
  - What happens if the project costs more?

- Refer to Module 3 for more information on the Cal-B/C Results worksheet and BCA metrics

3

INVESTMENT ANALYSIS
SUMMARY RESULTS

Life-Cycle Costs (mil. $)	$254.5
Life-Cycle Benefits (mil. $)	$903.5
Net Present Value (mil. $)	$649.1
Benefit / Cost Ratio:	3.6
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TOTAL BENEFITS	$852.1	$51.4	$903.5	$45.2
Person-Hours of Time Saved			126,198,340	6,309,917

Should benefit-cost results include:

1) Induced Travel? (y/n)	Y	Default = Y
2) Vehicle Operating Costs? (y/n)	Y	Default = Y
3) Accident Costs? (y/n)	Y	Default = Y
4) Vehicle Emissions? (y/n) includes value for CO_2e	Y	Default = Y

	Tons		Value (mil. $)	
EMISSIONS REDUCTION	Total Over 20 Years	Average Annual	Total Over 20 Years	Average Annual
CO Emissions Saved	137	7	$0.0	$0.0
CO_2 Emissions Saved	65,799	3,290	$0.8	$0.0
NO_X Emissions Saved	49	2	$0.1	$0.0
PM_{10} Emissions Saved	1	0	-$0.0	-$0.0
$PM_{2.5}$ Emissions Saved	1	0		
SO_X Emissions Saved	1	0	-$0.0	-$0.0
VOC Emissions Saved	28	1	$0.0	$0.0

05

Conclusion

In this module, you learned…

- How to perform a BCA of a hypothetical HOV lane construction project
- What data sources can be used for this type of project
- How to review the corresponding BCA results with real numbers

What's Next?

- **Module 10** is the final module in this training series and provides additional information and data sources for BCA in Cal-B/C tools