Caltrans Interstate 15 Reversible High-Occupancy Lanes: 1994 Status

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This paper details the present status of a 12.9-km (8-mi) two-lane reversible high-occupancy-vehicle facility implemented in the median of Interstate 15 freeway in the city of San Diego, California, in 1988. It covers the background of the project, design, and operation of the resulting facility, the results of a 1991 major project assessment, the present traffic service conditions, special uses of the lanes, traffic data, and an approved congestion pricing pilot program utilizing the lanes. Implementation of this demonstration program is expected to begin during the summer of 1995.

In October 1988, a 12.9-km (8-mi) section of reversible high-occupancy-vehicle (HOV) lanes on Interstate 15 (I-15) in the city of San Diego, California, was opened to traffic. The lanes are situated in the median of eight-lane I-15 and run without intermediate access or egress from the junction of I-15 and State Route 163 (an eight-lane freeway serving the San Diego central business district) to State Route 56. They operate in the southbound direction (inbound) in the morning from 6:00 a.m. to 9:00 a.m., and in the northbound (outbound) direction in the afternoon from 3:00 p.m. to 6:30 p.m. Their use is limited to car pools (two or more occupants), van pools, buses, emergency vehicles, and motorcycles. The geometrics of the lanes showing the a.m. and p.m. configurations are demonstrated as Figures 1 and 2.

Growth of HOV use has been moderate but steady, as shown in Table 1, with the percentage of person trips using the lanes remaining at approximately 20 percent for the past few years, or roughly equivalent to a fifth lane on the existing freeway.

The freeway in this area is being improved operationally with the addition of ramp metering, some HOV ramp meter bypass lanes, and auxiliary lane construction. There are no present plans to provide interim access to the reversible lanes; however, the implementation of the ramp metering should improve present problems of congestion that occur downstream of the end of the facility in both the a.m. and p.m. peak periods. This, coupled with the delays to those using the ramp meters, should provide marginal incentives for increased use of the reversible lanes.

Since late in 1991, the lanes have been used for a variety of tests and special events when not in HOV service. Most of the tests have involved automatic braking systems, whereas much of the special event use has been to conduct bicycling events.

Approval has recently been received to use these reversible lanes as a congestion pricing demonstration under the FHWA newly expanded congestion pricing pilot program established by the Intermodal Surface Transportation Efficiency Act (ISTEA). In 1993, the California Legislature approved and the governor subsequently signed Assembly Bill 713 (Goldsmith), providing legal authority for single-occupancy automobile use of the I-15 reversible lanes to test a premium travel lane concept. A draft work plan for this test program, titled Project Feasibility Tasks, is presented herein as Table 2.

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BACKGROUND

I-15 has one of the fastest growing traffic volumes in the entire San Diego regional highway network. Figure 3 schematically indicates the 1988 and 1993 traffic volumes of the subject corridor at the limits and at significant intermediate points. The recent recession, along with recent cutbacks in the defense industry, has had considerable adverse impact on the San Diego region. This is an especially large factor in slowing the region's growth, which had been causing the I-15 traffic volumes to increase by approximately 10 percent per year from 1980 to 1990. Since 1990, traffic growth in this corridor has slowed to approximately 1 percent per year, which is still above the area's current population growth rate.

The I-15 freeway was identified in the early 1970s as a corridor for mass transit applications. It is for this reason that all subsequent construction has included a dedicated 21.3-m (70-ft) median for possible future transit use. Early identification of a car pool/transit strategy in this corridor was a key item in pursuit of this project. The HOV strategy, as developed in the early 1980s, was a compromise between a fixed guideway mass transit facility and highway interests.

The subject HOV facility is a segment of the I-15 freeway between several bedroom areas of San Diego on the north ends (Penasquitos, Carmel Mountain Ranch, Poway) and a high-employment area on the south end (Kearny Mesa and downtown San Diego). Another unique feature is that these lanes pass through the Miramar Naval Air Station. This naval base severely constrains alternate route development in this corridor. The reversible lanes provide an attractive alternative for the traveling public.

The construction of the express lanes was accomplished with three separate contracts. First, two contracts were let to modify and construct bridges in late 1984 and early 1985. When they were completed in March 1987, the roadway and control systems contract began. The total cost of these projects was $32 million.

DESIGN AND OPERATION FEATURES

The HOV facility consists of two 3.7-m (12-ft) lanes, with 3.2-m (10.5-ft) shoulders on both sides separated from the main lanes by either New Jersey-type barriers or fencing, where there is an ample median. Figure 4 shows the facility during peak-period operation. The lane entrance-exit geometric features are indicated in Figures 1

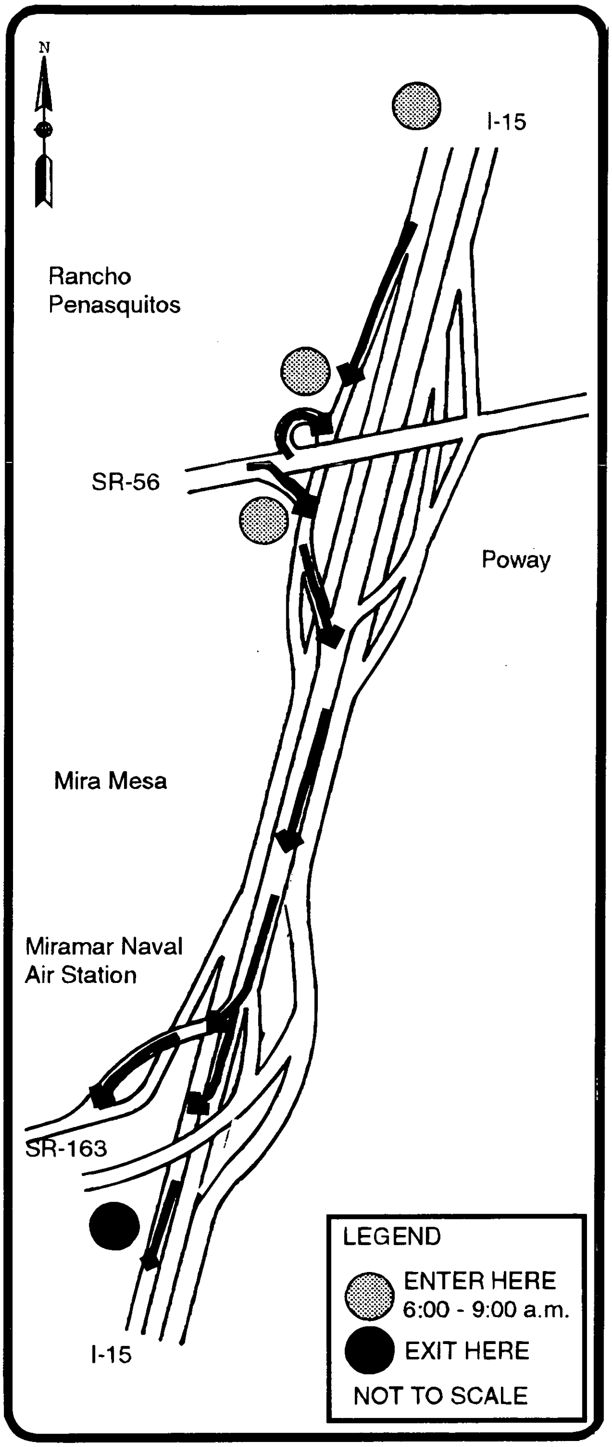

FIGURE 1 A.M. operation of I-15 reversible HOV lanes.

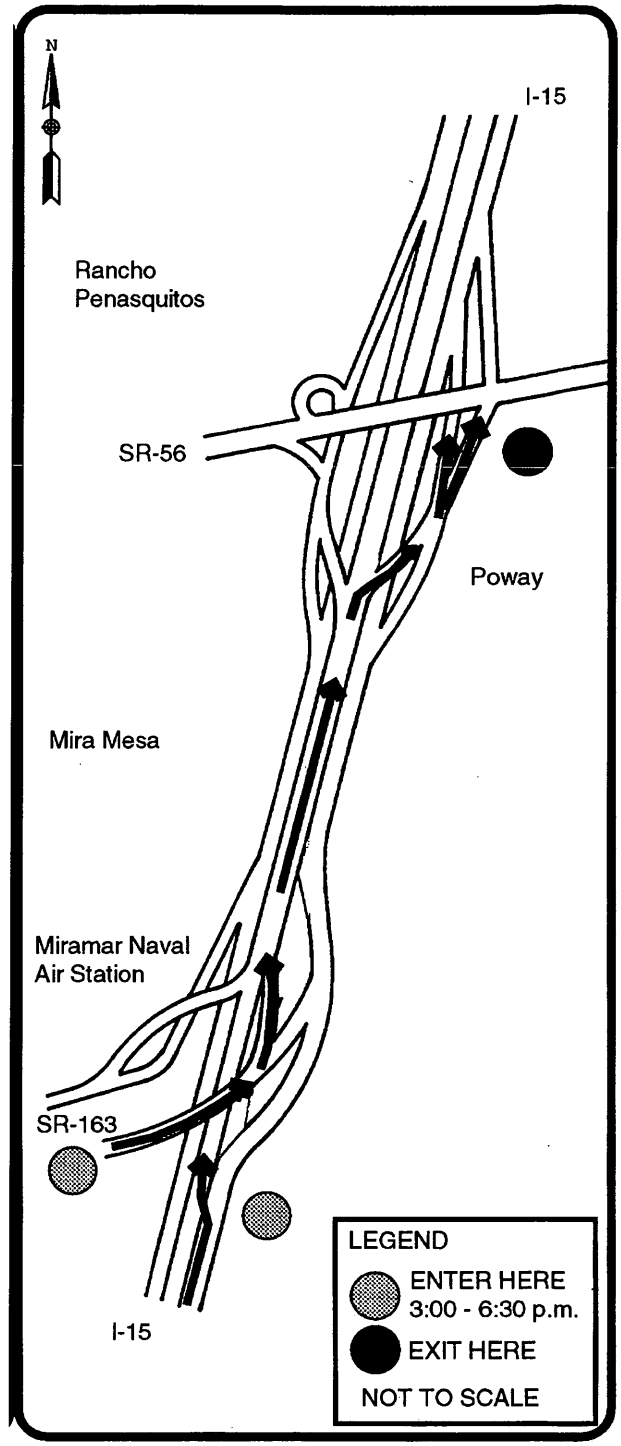

FIGURE 2 P.M. operation of I-15 reversible HOV lanes.

and 2. Figure 5 indicates the direct connector ramps at the northerly end of the HOV facility.

The original plan for the control system design and the development of the control system software was to be completed by consultant contract, because state employees had limited expertise in this field. However, only one bid was received on the contract, and in December 1987, that contractor went bankrupt.

The hardware design was only partially complete and the software barely started. The remaining implementation time was extremely short, and critical deadlines existed because of the state's contractual obligation to furnish the control system as part of the major construction project. A team of state employees was formed to accomplish the task of designing the control system, developing the software, and implementing the system. Various interdependent

TABLE 1 I-15 EXPRESS LANES FACILITY SUMMARY

Month/ Year	Volume Vehicles			Person Trips			
	HOV Peak Hour	HOV[a]	Main Lanes[a]	HOV[a]	Main Lanes[a]	Total[a]	%[b]
Nov. 1988	1,944	4,434	58,269	9,134[d]	64,096[d]	73,230	12.5
May 1993	3,433	8,676	62,295	18,341[c]	68,964	87,305	21.0
July 1993	3,241	8,414	61,958	17,814	68,153	85,967	20.7
Sept. 1993	3,127	8,223	64,444	17,416	70,888	88,304	19.7
Nov. 1993	3,215	8,301	58,448	17,902	64,293	82,195	21.8
Jan. 1994	3,518	8,982	62,436	19,194	68,679	87,873	21.8
Mar. 1994	3,644	9,155	69,286	19,485	76,215	95,700	20.4
May 1994	3,171	8,133	57,866	17,309	63,653	80,962	21.4
Jun. 1994	3,480	8,979	68,220	19,109	75,042	94,151	20.3

[a] *a.m. (0600–0900) + p.m. (1500–1830)*
[b] *HOV lanes as % of total.*
[c] *From May 1993 through June 1994, HOV Person Trips have consistently been twice the value for November 1988, the first full month of operation.*
[d] *The Total Person Trips (HOV + Main Lanes) grew 28.6% between November 1988 and June 1994. The HOV Person Trips grew 109.2% in the same period.*

efforts had to be performed concurrently, where normal work flow would have dictated sequential completion of dependent tasks. The tight schedule was maintained, and the lanes were opened to traffic on October 20, 1988.

Opening-closing devices and emergency features were built into the project as follows:

1. Overhead flip disc changeable message signs. Four signs are upstream of each entrance location, displaying a variety of messages. Figure 6 indicates one of these changeable message signs.
2. Several rows of pop-up delineators. These are operated pneumatically, with positive pressure necessary for raising or lowering the delineators. There are also loop detectors located to gather vehicle speeds and volumes on the main lanes, as well as on the HOV lanes. Additional detectors are placed in advance of the entrances to detect a gap in traffic before raising the pop-ups and closing an entrance.
3. Standard luminaires. These draw lights illuminate the entrances and exits when they are open, and remain dark when they are closed.
4. Semaphore bridge gates. The gates look like railroad gates, but do not have the breakaway features. They lock into the barrier rail and consist of two 1.3-cm (0.5-in.) aircraft carrier cables surrounded by an aluminum shell. These gates are closed at an entrance when the express lanes are open in the opposing direction and, as of this report, have not been hit in the 8 years of operation. Figure 7 indicates a barrier gate and a row of pop-up delineators.

The emergency features consist of the following:

1. Call boxes placed at 0.8-km (0.5-mi.) intervals. They were financed on all freeways in San Diego County by additional vehicle registration fees. These telephones allow a disabled motorist to contact the California Highway Patrol (CHP) and obtain assistance.
2. Motorcycle openings or removable guardrail openings at approximately 1.6-km (1-mi.) intervals. The 1.8-m (6-ft) motorcycle openings in the barrier have crash-cushion protection for barrier end sections in both directions. This allows CHP motorcycle ingress or egress from the facility for enhanced enforcement and quicker emergency response. The removable guardrail openings provide a 3.8-m (12.5-ft) opening by simply loosening wing nuts. This can be done in approximately 1 min, and permits entrance and exit by larger emergency vehicles.

There are five field locations at which opening-closing devices are operated. At each, there is a device control unit (DCU) for the devices within the general vicinity. The DCU consists of a Versa Module Eurocard bus M68000 microcomputer mounted in a modified Type 334 traffic control cabinet. The DCUs control barrier gates, pneumatic pop-up traffic delineators, and entrance-exit lighting. They control roadway opening-closing sequencing and maintain total system status based on feedback from gate arm position switches, pressure limit switches, analog pressure sensors, and vehicle detectors. Each DCU location also has a manual control unit that houses manual controls for emergency and maintenance operations. Air reservoirs provide temporary redundancy for operation during compressor or air delivery line failures.

TABLE 2 Project Feasibility Tasks

	Task	Responsible Agency[a] SANDAG	CAL-TRANS	M[b]
1	Determine if project violates state or federal laws or regulations.		X	3
2	Determine how project affects goals and objectives of HOV program.		X	3
3	Coordinate proposal with federal and any other agencies who might have interest in proposal.		X	3
4	Conduct surveys of existing and possible users in corridor to determine their attitudes to congestion pricing.	X		4
5	Determine long-term effects which the proposal will have on regional HOV programs.	X		4
6	Determine transit improvements resulting from implementation.	X[c]		4
7	Determine federal and state design and safety requirements necessary to implement project.		X	4
8	Determine long-term impacts which congestion pricing might have on HOV operations at other locations.		X	4
9	Make preliminary investigations on the aspects of access, egress, merging, toll collection, and enforcement.		X	5
10	Investigate possibility of truck usage.		X	5
11	Determine capacity of HOV lanes to ensure they can operate at LOS B or better after implementation of project. (Include merging conflicts at north and south ends.)		X	5
12	Make preliminary estimates of the amount of the user's fee for single occupant vehicles.	X	X	5
13	Determine the cost/benefit of proposal.	X		5
14	Determine the amount and source of any additional funds above those collected which may be necessary to implement, operate, and maintain project.	X		5

(contineud on next page)

TABLE 2 *Continued*

	Task	Responsible Agency[a] SANDAG	CAL-TRANS	M[b]
15	Make a preliminary policy decision to proceed or abort project.		X	5
16	Determine how fees will be collected.	X	X	6
17	Determine method of enforcement.[d]		X	6
18	Determine cost of enforcement.[d]		X	5
19	Determine operating strategy.		X	6
20	Determine other facilities in the state where this strategy could be implemented if it proves feasible.		X	5
21	Identify improvements necessary for the main lanes, toll areas and the merging and converging areas near the north and south access points.	X	X	6
22	Develop a method to measure and monitor changes in level of service for HOV and mixed-flow lanes resulting from project.		X	6
23	Determine methods necessary to measure improvements in air quality and fuel savings resulting from project.		X	6
24	Determine how and when program will be terminated if necessary.	X	X	6
25	Conduct a public hearing on proposal.	X	X	7
26	Develop a marketing strategy for all users in corridor.	X	X	7
27	Prepare an environmental document if required.	X	X	7
28	Make final policy decision to proceed or abort project.		X	7
29	Final report.	X	X	9

[a] *San Diego County Regional Transportation Commission (SANDAG) or California DOT (CALTRANS).*
[b] *Number of months from initiation to completion.*
[c] *In cooperation with Metropolitan Transit Development Board.*
[d] *In cooperation with California Highway Patrol.*

Three DCUs are connected to the south-end control building's field control unit (FCU), which is a computer system similar to the DCU. The FCU supervises the three DCUs and the eight changeable message signs on the south end via a serial line communications system over twisted pair cables and line drivers. Each DCU sends complete device status information to the FCU every 15 sec and whenever a device status change is detected. The changeable message signs are polled for correct status every 6 mins.

Two DCUs are connected to the north-end control building's FCU, which serves a similar function as the south-end FCU. There are four changeable message signs at the north end. Both control buildings house compressors with filter systems, pressure tanks, automatic backup diesel generators, and power distribution and ground fault interruption equipment. In addition, the north-end control building has a maintenance and spare parts storage facility.

The two FCUs are connected via leased dedicated telephone lines and modems to a traffic system unit (TSU) in the Transportation

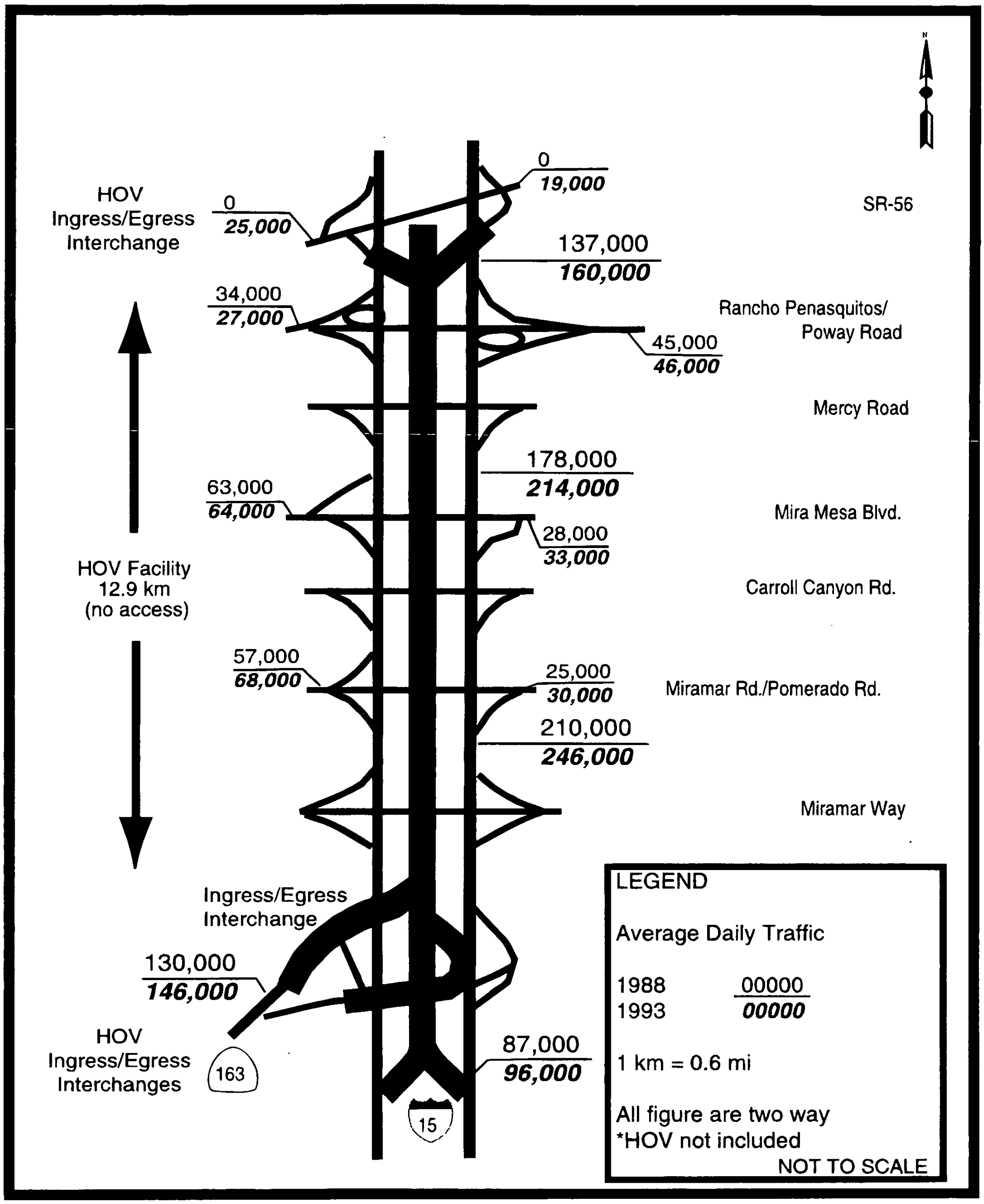

FIGURE 3 I-15 HOV schematic corridor traffic volumes and interchanges.

FIGURE 4 HOV during operation. Reversible HOV facility in median. Northbound traffic Level of Service (LOS) F at p.m. peak period near southerly entrance.

Management Center in the Old Town area of San Diego, which is approximately 16 km (10 mi) from the south end of the HOV lanes. The TSU computer is similar to the other VME bus computers in the system. The system is controlled completely by an operator at this location.

The software for each of the eight microcomputers in the control system is identical. On start up, the software performs hardware validation checks and identifies which unit is in the system. The operating system is a small real-time multitasking operating system called OSENGINE. Most of the application software is written in C language. Communications drivers and device drivers were written in 68000 ASSEMBLY language. All of the application software was developed under the UNIX operating system.

For roadway operation, the operator utilizes prompted English

FIGURE 5 Direct connector ramps at northerly end of HOV facility. State Highway 56 interchange is at top.

FIGURE 7 Entrance ramp to HOV. This is northbound entrance from State Highway 163. It indicates hydraulic pop-ups and barrier gate. At this time, HOV facility is closed. When access is allowed in this direction, pop-ups are down. When HOV is open in opposite direction, pop-ups are up and gate is down.

language commands (e.g., closure of northbound I-15 entrance is effected by entry of the command "Close south-end 15 entrance"). A security system that assigns specific security levels to each operator is incorporated. The security levels govern access to the various types of commands available in the system. A system error log is maintained.

FIGURE 6 Changeable message sign.

Great care was taken in the design and development of the system to ensure safe operation. The software prevents an operator from operating the devices in an improper sequence, such as lowering a barrier gate without the corresponding pneumatic pop-up delineators in place. Each computer in the system monitors the status of all closure device sensors in the system, and prevents operation of closure devices unless complete system status is known and proper.

The performance of the reversible roadway communications system under marginal line conditions is currently being improved, along with mechanisms to improve the operation and safety of the system under conditions of sensor malfunction.

Further modifications to the system are proposed, incorporating the reversible roadway control system into a new and expanded TMC. The modifications would integrate the reversible roadway control system with the new TMC computer systems and make the twelve changeable message signs in advance of the north-end and south-end entrances available to the TMC for other transportation management purposes.

1991 PROJECT ASSESSMENT

Field work for a report based on extensive analysis undertaken over 3 1/2 years by the Department of Civil Engineering, San Diego State University, was finalized in 1990 (*1*). The study, published in 1991, is reported in seven parts as follows: Part 1, executive summary; Part 2, volume/occupancy study; Part 3, speed/delay study; Part 4, land use study; Part 5, park and ride study; Part 6, bus study; and Part 7, attitudinal study.

The major findings of the assessment were:

- The lack of interim access/egress to the reversible lanes has caused some reverse travel to utilize the facility.
- The 2+ occupants per vehicle HOV designation is appropriate.
- The decision to build the HOV lanes as a reversible facility is justified, as the minor direction of travel during the peak periods is only approximately 60 percent of the volume of the major travel direction.

- During the first 2 years of the HOV lane operation, a conservative $30 million was saved through decrease in delay in the corridor.
- The then existing park-and-ride facilities were not adequate. In addition, only two of the eight facilities between Route 78, 17.7 km (11 mi) north of the project, and Mira Mesa Boulevard were judged well placed to serve the HOV lanes.
- Bus and van pool use was found to be relatively low for such a facility, as exemplified by the overall occupancy rate of 2.3 passengers per vehicle.
- The March 1991 bus survey indicated an average increased ridership of 53 percent over the first 3 months of service on the facility.
- Attitudes toward the HOV lanes were found to be "strongly positive" or "positive," but declined slightly from 1988 (77%) to 1990 (70%).
- The most common complaints were: "Lanes should be open to all traffic" and "I would like to use the lanes, but I cannot access them."
- A survey of new homeowners in the area identified that over 22 percent indicated that their home purchase was related to the availability of the HOV facility.
- The average car pooler believed the HOV lanes saved 22 min and approximately $3 per day. The observed time savings at the present time is approximately 15 min for the round trip during the most congested time frames. The cost savings is subjective and is perceived very differently by the users.
- Average speed on the mixed-flow lanes increased from 61 kph (38 mph) pre-opening to 90 kph (56 mph) in 1990 (*1*).

This assessment report concludes that the primary factors contributing to the success of the HOV express lanes are:

- The HOV lanes were added, not taken away from the main lanes.
- The relaxed car pool definition (2+ persons per vehicle) is very helpful at the current stage of the facility use. The fraction of vehicles with 3+ persons is still rather small. Contributions from buses and cars with 3+ passengers are growing fast, but are still relatively low.
- The technical performance of the HOV facility has been excellent, and the system is enjoying a positive public image.
- As Level of Service A is virtually always offered, the reward for using the facility is well defined and reliable.
- The HOV facility is long enough, 12.9 km (8 mi), for commuters to notice the advantages of use.
- This solution to increasing HOV commuter traffic is compatible with transportation and environmental policies, and is considered right for the region by the vast majority of the population.
- The lanes have received mostly positive media attention (*1*).

PRESENT TRAFFIC SERVICE CONDITIONS

At the present time, the reach of I-15 served by the reversible HOV lanes is a full eight-lane freeway, with auxiliary lanes at several locations and operating ramp meters at all of the southbound ramps and most of the northbound ramps. Ramp meter HOV bypass lanes exist at many of the above southbound lanes, but they are also controlled by the metering. Therefore, some of the advantage of the bypass is lost, especially for buses, which often must come to a stop at the meter.

The provision of well-placed and well-sized park-and-ride lots offers an opportunity to increase the percentage of car pools and transit riders in the corridor. Figure 8 identifies the existing park-and-ride lots within the subject portion of the I-15 corridor. The limits shown are State Route 52, 1.6 km (1 mi) south of the southern end of the HOV lanes, and State Route 78, 18 km (11 mi) north of the northern end of the HOV lanes. The lots shown are those within 1.6 km (1 mi) of I-15. However, the lack of intermediate access to the HOV lanes negates or reduces the value of several of the lots. Four lots are located between 4.8 and 18 km (3 and 11 mi) north of the HOV facility.

The following chart shows the park-and-ride facility regional identification number, the number of parking spaces, the percentage of occupancy, and the availability of local or express bus service. The lots have been grouped using a subjective evaluation of their accessibility to the HOV lanes.

Good Access to HOV [located upstream (northerly) of HOV facility]

Regional Lot No.	*No. of Spaces*	*Percent Occupied*	*Served by Local Bus*	*Served by Express Bus*
3	20	100	Yes	No
11	140	34	Yes	No
54	200	39	Yes	Yes
65	16	100	Yes	No
Subtotal	376			

Reasonable Access to HOV (near upstream end of HOV facility)

Regional Lot No.	*No. of Spaces*	*Percent Occupied*	*Served by Local Bus*	*Served by Express Bus*
4	104	30	Yes	Yes
18	103	25	Yes	Yes
26	125	30	Yes	Yes
31	67	95	Yes	Yes
53	93	61	Yes	Yes
57	132	19	Yes	Yes
Subtotal	624			

Poor Access to HOV (out of travel direction)

Regional Lot No.	*No. of Spaces*	*Percent Occupied*	*Served by Local Bus*	*Served by Express Bus*
16	103	39	Yes	Yes
51	44	48	Yes	Yes
Subtotal	147			

No Access to HOV

Regional Lot No.	*No. of Spaces*	*Percent Occupied*	*Served by Local Bus*	*Served by Express Bus*
6	221	33	No	Yes
58	44	77	Yes	No
Subtotal	265			

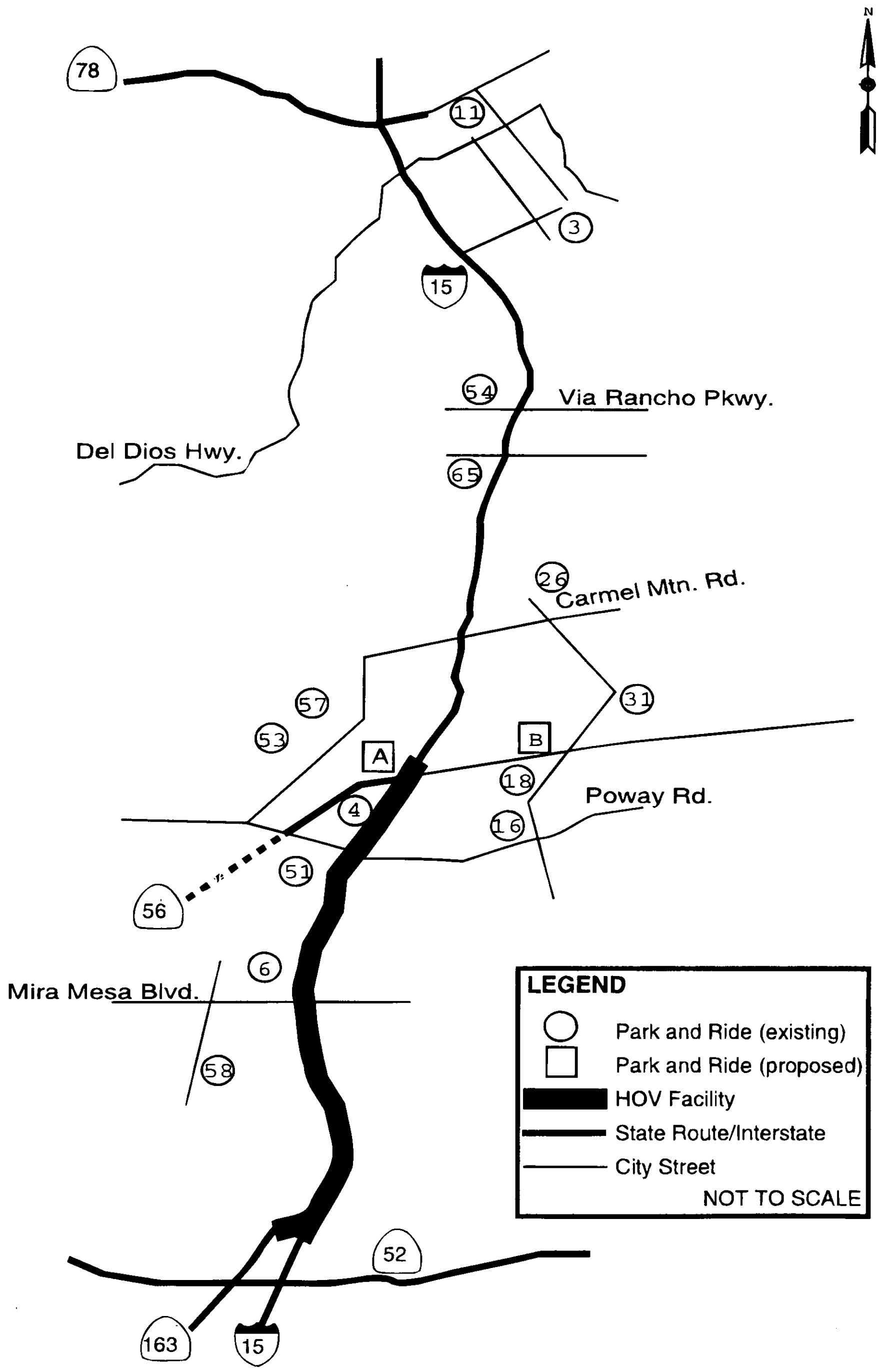

FIGURE 8 Park-and-ride location I-15 corridor.

The project report that was prepared before the construction of the HOV lanes identified two park-and-ride locations to be built as part of the HOV project. These locations are identified in Figure 8 as Sites A and B. However, funds were not programmed for these facilities. Lot A was to be sited within excess freeway right of way, and would have provided 250 spaces with excellent HOV access. Lot B would have provided reasonable HOV access, but required the purchase of right of way. This lot was planned to provide 400 spaces. A smaller lot, No. 18, with 103 spaces has been built at this location, and opened in January 1995. Undeveloped land is no longer available to expand this location.

Bus service along the corridor is nominal. San Diego County Transit System (CTS) operates six southbound express bus trips from Escondido to downtown San Diego. These trips use the HOV lanes in the morning peak period and return northbound on the HOV lanes during the afternoon peak period. This route serves park-and-ride Lot Number 54. CTS also provides four southbound express trips from Poway to downtown San Diego, using the HOV lanes and returning on the HOV lanes during the evening. This route serves park-and-ride Lots 16 and 18.

San Diego Transit (SDT) also provides peak-period express bus service on the HOV lanes. Six morning trips are provided from the North County Fair shopping mall in Escondido (adjacent to park-and-ride Lot 54) to downtown San Diego. Return trips are provided on the HOV during the evening peak period. Service is provided to park-and-ride Lots 26, 31, and 54. SDT also provides six southbound express bus trips from Rancho Penasquitos to downtown San Diego, using HOV lanes during the morning and returning on the HOV lanes during the evening peak period. This route serves park-and-ride Lots 4, 53, and 57. SDT provides all-day express bus service on one additional route that operates on the mixed-flow lanes of I-15. This route serves park-and-ride Lots 4, 6, 51, 53, 54, and 57.

Greyhound Bus Lines uses the HOV lanes during the evening peak period for two intercity routes going northbound to Riverside County and beyond.

Local bus routes operated by North County Transit, SDT, and CTS provide feeder service to the park-and-ride lots, as indicated in the previous charts. They also provide transfer opportunities at various bus stops shared by the express bus and local bus routes.

The project report identified that the exclusive reversible HOV two-lane facility would provide needed increased freeway capacity in the peak direction of traffic and would encourage increased ride sharing, thus decreasing total vehicle demand. Both of these expectations have been at least partially fulfilled. However, as the adjacent freeway lanes have not reached the projected level of congestion, incentive to use the HOV facility has not reached the expected level. Two factors have kept the present congested level lower than projected: the overall reduction in traffic growth attributed to the present economic slump and the effects of improved freeway operations resulting from ramp metering and recent auxiliary lane construction.

SPECIAL USES

One unanticipated use of the facility has been as a testing facility for automatic braking systems and for video cameras.

Because the express lanes are a long, high-standard 112-kph (70-mph) design speed barrier-separated facility, they are an ideal test site for various new technology applications. The following represent some of the testing and research activities that have utilized the express lanes:

- Radar-controlled collision avoidance systems.
- Vehicle performance evaluation on wet pavement.
Automatic lateral guidance systems.
- Laser-controlled lane stripe maintenance.
- Close circuit television testing.

These tests (many of them are ongoing) have been sponsored by a variety of private and academic institutions working in cooperation with Caltrans.

TRAFFIC VIOLATIONS, ENFORCEMENT, AND ACCIDENT RATE

Since opening in 1988, the average vehicle occupancy in the express lanes has been approximately 2.2 persons per passenger vehicle. If public transit bus ridership is included, then the occupancy rate increases to 2.3 persons per vehicle.

The California Highway Patrol reports that its task of enforcing the minimum vehicle occupancy rate is relatively simple for the following reasons:

- The 12.9-km (8-mi)-long express lanes have no intermediate points of egress or access. Once a vehicle enters the system it must remain there in clear view of officers for the entire trip. Relatively low-lane density makes it easy to spot violators.
- Although most enforcement effort is concentrated at the points from which vehicles leave the system, the generous roadway cross section makes enforcement easy and safe at any point.
- The penalty for receiving a citation is substantial. In 1994, the fine was approximately $270, and the citation counts against the driver's record as a safety infraction (failure to obey an official sign).

For these reasons the violation rate in the express lanes is remarkably low. Manual counts show a violation rate of approximately 1.5 percent of total express lane traffic.

Operation of the express lanes has been almost accident-free. From opening day in October 1988 through mid-1994, the facility was operated approximately 1,500 days. In that time, there have been only eight recorded accidents. The accident rate is 0.07 accidents/million vehicle-kilometers (MVkm) (0.12 accidents/million vehicle-miles (MVM). By comparison, the adjacent freeway mixed-flow lanes have an accident rate of 0.4 accidents/MVkm (0.66 accidents/MVM) during the same hours in which the express lanes are open.

A special feature of express lanes operation is that they may be opened to all traffic under specified emergency conditions when freeway main lanes may be blocked by an accident. This bypass feature has been brought into play approximately once per year, when accidents cause two or more of the adjacent mixed-flow lanes to be blocked for an extended time during the commute peak period.

CONGESTION PRICING PILOT PROGRAM

In late January 1993, the regional planning agency, the San Diego Association of Governments (SANDAG), submitted an application (*2*) for participation in the FHWA ISTEA-established congestion pricing pilot program. Earlier, in 1991, SANDAG applied to the Federal Transit Administration (FTA) for a transit development and congestion pricing demonstration grant. Since approval of the FTA grant request in late 1992, public and private interest in a congestion pricing demonstration program utilizing the I-15 reversible lanes has grown.

In 1993, state legislation was introduced and subsequently passed into law to allow implementation of roadway pricing on this facility if it were to be designated as a federal congestion pricing pilot program. This legislation stipulates a number of conditions, including that the program apply only to the I-15 reversible lanes; that the resulting available revenue be used for transit; and that, although single-occupant vehicles are authorized to use the high-occupancy lanes for a fee, this not reduce the use or access of the lanes by HOVs.

The SANDAG approach to congestion pricing in general is based on the following principles:

- It is a tool by which to achieve wide regional objectives, such as traffic congestion relief, improved air quality, and improved mobility.
- It should be implemented in stages, each of them based on technical analysis, public involvement, and political acceptance.
- Each stage must be a balance between what is technically and theoretically desirable and what is politically feasible (*2*).

The specific objective of the I-15 pilot program was identified as to promote maximum utilization of the HOV lanes and to reduce corridor congestion through the use of a market approach providing a premium price for single-occupancy vehicle (SOV) use, based on time savings and replacement costs associated with the use of uncongested HOV facilities.

The 1993 SANDAG grant request was denied by the FHWA in February 1994 on the basis that it did not qualify because it was an HOV buy-in project to allow SOV use of the HOV lanes. At that time, this concept was not allowable. The rejection letter, however, announced the extension of the solicitation for projects and a program to fund development of potential pricing projects (G.J. Jeff, unpublished data. Then the FHWA, by *Federal Register* notice of May 25, 1994 (*3*), expanded and liberalized the program to the point that by letter of June 24, 1994, SANDAG resubmitted its original proposal and proposed that federal congestion pricing pilot program funds be used to support the initial engineering, technology, identification of possible transit enhancement, and evaluation of the pilot project. Furthermore, SANDAG proposed that the detailed budget and matching funds determination be subject to negotiation of a cooperative agreement.

The original SANDAG proposal lacked the way very important planning stage needed to guide the decision to implement the program and the details of such an implementation. Consequently, SANDAG and Caltrans have worked together on a plan to address issues and procedures. The resubmitted application has recently been approved. The pilot program will be implemented in two stages over a period of 3 years.

The first stage would involve low-level technology using prepurchased identification allowing drive-alone users to enter the HOV facility without stopping to pay a cash toll.

In the second stage, an electronic toll collection and traffic management system would be utilized. Extensive testing and use of such strategies as automated vehicle identification and electronic toll and traffic management concepts could be involved in this second phase.

The work plan is presently being finalized and is expected to address the 29 tasks included in Table 2. The final work plan for this program is being developed cooperatively by SANDAG and Caltrans, and will be approved by both agencies.

FUTURE POSSIBILITIES

Besides the planned implementation of the first phase of the proposed congestion pricing pilot program in the summer of 1995, a variety of related studies involving this portion of I-15 are either underway or proposed. These studies include:

- An ISTEA Section 1005 study of the economic lifeline corridor.
- A study of possible upgrading of transit services between Escondido and San Diego, with several options being considered, including light rail.
- A Caltrans regionwide update study of the HOV/ramp meter system.
- A Caltrans review of the park-and-ride system throughout the area.

Depending on the results of these various studies, actions will be taken to further enhance the effectiveness and efficiency of the subject current reversible HOV facility.

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