ARCADIS
Infrastructure, environment, facilities

Imagine the result

Orangeline Development Authority & ARCADIS – A Public Private Partnership

MILESTONE 2

ORANGELINE HIGH SPEED MAGLEV PROJECT

SYSTEM CONCEPTS

Adopted December 14, 2005

ARCADIS

Milestone 2 – Orangeline High Speed Maglev System Concepts

Prepared for:
Orangeline Development Authority &
ARCADIS – A Public Private Partnership

Prepared by:
ARCADIS G&M, Inc.
630 Plaza Drive
Suite 200
Highlands Ranch
Colorado 80129
Tel 720 344 3500
Fax 720 344 3535

Our Ref.:
CA000672.0001

Date:
December 14, 2005

Information provided in this report is subject to revision in future project development phases.

Orangeline Development Authority

Orangeline Corridor Development Project

Milestone 2 – System Concepts and Criteria

Introduction

This report is the second in a series of reports documenting progress in the planning of the Orangeline Corridor Development Project. Adoption of each of these reports by the Orangeline Development Authority Board represents a key milestone in the deployment of the Orangeline.

This Milestone Report sets the focus of the technical work for the balance of Phase 1 Preliminary Engineering. The Report provides a list of system requirements and goals; project criteria for evaluating alternatives; identification of the general system concepts that meet the requirements of the project; and the development of the preliminary opportunities and constraints analysis of the project corridor.

The purpose of Milestone 2 is to establish key policy direction for further project development work and to provide the source document for the fundamental reasoning behind the Orangeline Corridor Development Project. Milestone 2 shapes the development of the project alternatives and defines a set of measurement standards that can be used to evaluate alternatives. Further, Milestone 2 identifies system concepts that are judged to satisfy the project goals and objectives. Milestone 2 forms the foundation for subsequent phases of project development.

The key components of Milestone 2 are:

- System Goals and Requirements
- Project Evaluation Criteria
- System Concepts
- Opportunities and Constraints
- Base Mapping

System Goals and Requirements

The primary goals of the Orangeline Corridor Development Project are to:

- Support the economic and land development goals of the Authority's member agencies;
- Provide an alternative transportation choice to avoid traffic congestion in the Orangeline Cities corridor;
- Improve travel access and efficiency in the high-density, fast-growing Project corridor;
- Enhance regional connections by providing more ways to move people and goods;
- Improve transportation safety by providing a safe mode of travel that is physically separated from other ground modes;
- Provide for improved ground connections for both air passengers and cargo between Palmdale Airport and other travel origins and destinations in the corridor;
- Provide for an expandable high-speed ground transportation system that connects the corridor to the region and other destinations statewide;

- Foster an expanded employment base by connecting jobs with more lifestyle options;
- Reduce the need for costly and environmentally disruptive expansion of freeways in the corridor;
- Improve regional air quality by reducing vehicle emissions; and,
- Serve the freight market, including the movement of container cargo if feasible, between San Pedro Bay ports and a possible inland port in Palmdale and avoid adversely impacting the movement of passengers.

A set of guiding principles is applied in the development of Project alternatives. Guiding principles are ideals to be considered as the foundation in Project development. The following will serve as the guiding principles for the Project:

- Plan for the future, not the present
- Plan for the Project to pay its own way
- Plan for the enhancement of the communities
- Plan for sensitivity to current needs and future opportunities
- Consider community input during Project development

To meet the goals of the Project, the Orangeline maglev system would be designed to fulfill seven major functional roles:

1. **Create Sufficient Value to System Users to Recover Capital and Operating Costs from Project Operations.** The key role of the Orangeline Maglev is to provide a high quality transportation service that will attract sufficient users and operating revenues to cover development and operating costs. The system must be competitive with alternative travel options and not rely on government grants to subsidize construction or operating costs. Government support in providing public rights-of-way is assumed and credit enhancements, including loans and loan guarantees, are anticipated as possible strategies for reducing financing costs. Government grants to help carry out initial planning work is also anticipated.
2. **Create Value for Orangeline Cities.** This role is aimed at providing high quality access and mobility within the corridor that is competitive with the automobile and that enables Orangeline Cities to achieve their General Plan and land use goals for housing, retail and commercial development and enhanced economic and environmental conditions. The value provided by the Orangeline Maglev would be manifested in higher property values and prosperity for residents of Orangeline Cities. The system would stimulate economic development, which would in turn generate increased revenues for member cities. A key role of the Orangeline is to protect designated residential areas from intrusive development by focusing future housing, commercial, retail and similar development around Orangeline stations and along feeder routes served by high-quality public transit services.
3. **Provide an Equitable Distribution of Economic Benefits to all Member Agencies**
   The Authority's member agencies are all striving to create a quality living environment for their residents and ensure an economically strong and vibrant community. Due to various reasons, including state and federal policies, prior decisions, geography, development patterns and market forces, some member agencies are in a better position to achieve their goals than are others. An underlying principle of the Orangeline Corridor Development Project is that all member agencies are to be kept "whole" in the benefits to be derived from the Project. This means that the benefits derived from the Project will be distributed

equitably among all the member agencies, enabling all member agencies to come closer to achieving their goals.

4. **Provide Improved Airport Access in the Corridor.** Under this role, the high-speed maglev system would provide quick access to Palmdale Airport. The intent of this connection is to provide a more attractive alternative to LAX and Burbank airports, thereby enabling Orangeline Cities residents to avoid ground and air congestion at these airports. Air travel ticketing and baggage check-in should be accommodated at Orangeline stations.
5. **Reduce Corridor Traffic Congestion and Improve Air Quality.** This role is aimed at reducing freeway and surface street traffic congestion in the corridor. The Orangeline Maglev would provide high-speed access between population and employment centers. Commuters would access the system by walking from and to housing and job locations and other destinations within close proximity to Orangeline stations. Local public transit, bicycle, shared-ride and taxi modes would be favored for access to Orangeline stations. Auto access would be accommodated but station-area parking would be priced to reflect its true costs. Strategies would be employed by cities to reduce demand for auto usage and parking. Station areas would be planned to be pedestrian-friendly and serve as community activity centers.
6. **Provide Intra-regional Connections**. This is a role that addresses the opportunity to serve a market for high-speed travel to places beyond the boundaries of the corridor. Convenient connections would be provided to Metrolink, AMTRAK and regional public transit services to enable convenient travel to destinations outside the corridor. This role helps to fulfill the mission of the Orangeline to improve transportation in the region.
7. **Carry Freight and Serve or Accommodate Container Cargo.** The maglev system can be designed to carry freight containers. Containers could be loaded onto to maglev vehicles concurrent with passenger boarding. The system should also be designed to serve or accommodate the movement of cargo containers from seaports to an inland port in Palmdale if it is determined that the market could support such a system.

Evaluation Criteria

Evaluation Criteria are used to screen the range of potential design, engineering and operating alternatives that will be subjected to more detailed engineering and environmental review in Phase 2. The evaluation criteria are as follows:

- Ridership Potential
- Operational Impacts
- Engineering/Capital and Operations & Maintenance Costs
- Cost-Effectiveness
- Environmental Impacts
- Public and Agency Comments
- System Continuity
- Safety
- Regulatory/Permitting
- Construction/Constructability
- Connectivity
- Community Acceptance/Economic Potential
- Personal Traveler Criteria
- Job Creation/Project Benefits
- Financial and Partnering

The possibility that the Project will utilize federal credit enhancements under TIFIA or other federal programs requires that it comply with federal guidelines. The criteria that have been developed by the Federal Railroad Administration for the federal maglev deployment program, some or all of which may be applicable, are as follows:

- Maximization of Partnering Potential
- Developed Cost Forecasts
- Operations and Maintenance Plan
- Positive Benefit/Cost Ratio
- Financially Feasible
- Technology Transfer
- Satisfaction with Statewide/Regional Planning Requirements
- Approvable by FRA
- Maximizing Use of U.S. Materials
- Nationally Significant Project
- Attractiveness to Travelers
- Maximization of Congestion Relief
- Ability to Operate in Varying Conditions

System Concept

Initial maglev feasibility studies conducted for SCAG included a review of potential technologies and routing alternatives. Information about potential technologies and related suppliers, projects and operating systems can be found in the feasibility study reports available at the Orangeline website: www.orangeline.calmaglev.org. The feasibility studies evaluated:

- Technologies initially considered but not carried forward (such as local bus).
- Higher-speed, improved quality bus service. (such as El Monte Freeway bus)
- Conventional rail, (such as Metrolink or AMTRAK).
- High-speed rail, (such as the European ICE or the Japanese Shinkansen).
- High-speed maglev (such as Shanghai Maglev).

Further, the feasibility studies also evaluated technology criteria, including:

- System Performance
- Technology Applicability
- Project Fit
- Supplier/Team Qualifications

The system concept for the Orangeline is a high-speed maglev system operating on a totally grade-separated monorail-type guideway, designed primarily as an elevated structure located approximately 20 feet above the surface and along existing freeway, railroad and other public rights-of-way.

Orangeline stations would be spaced to serve cities along the corridor, with the spacing of stations determined by a combination of factors, including access to the system and average operating speeds. It is anticipated that by-pass guideways may be incorporated into the design to enable off-line stations for both passenger and freight access. By-pass guideways would also enable local and express services to be operated, thereby offering both high-quality longer distance and shorter distance services.

Exhibit 1 describes average and top speeds of maglev in normal operations. Exhibit 2 shows illustrative Orangeline travel times between cities. The data in Exhibits 1 and 2 are preliminary and may be adjusted as a result of further analysis.

Station-area and Corridor Development Concept

The Authority envisions the creation of new housing, commercial, retail and public space improvements around Orangeline stations in a form often referred to as Transit Oriented Development (TOD). Transit Oriented Development connotes development that is planned to facilitate or otherwise orient itself to the transit system. The Authority views the planning of the Orangeline from the opposite perspective. The Orangeline is seen as Development Oriented Transportation (DOT). That is to say, rather than viewing the Orangeline as a tool in stimulating a particular form of development, the Authority views the Orangeline as a response to market forces that are shaping future development in the corridor. The difference is both subtle and significant.

A number of factors are changing development patterns in the region. Development patterns in many cities in the region are in transition from building out to building up. Densification is a fact of life in the region as most of the land available for development in many cities has been fully built out – but not fully built up. Multiple-unit housing, mixed-use developments, multi-level schools and other public facilities historically developed at a single-story level are now appearing as high-rise developments.

As the region becomes denser, two factors become important. The first is the need to protect existing designated single-family residential areas from intrusive development and the need to create new public spaces required to support the growth in population. The second is to super-impose on the existing transportation system (primarily local streets and highways) a transportation system that better accommodates the requirements of a densely developed area.

The Orangeline is particularly well suited to serve areas designated for higher density development. In doing so, it can help to preserve areas designated for preservation of existing single-family residential development. Complemented with a quality public transit feeder and local circulation system (such as light or heavy rail, express bus, local shuttle and feeder buses, etc.), the Orangeline can readily support the creation of “urban village” development patterns that are emerging throughout the region and within many of the Orangeline corridor cities.

Employment- and other Population-Driven Markets

Population in the corridor is estimated to exceed 4 million people. Population density varies from city to city, reaching as high as 20,000 to 24,000 people per square mile in several Orangeline Cities (by comparison population densities in two other cities planning maglev systems, Pittsburgh and Las Vegas, are 6,000 and 4,000 people per square mile, respectively). Previous feasibility studies indicate that the population in the regional statistical areas that comprise the Project corridor is expected to increase by more than 1 million people within the next 20 years and employment growth of nearly 1 million jobs is also possible during this period.

In the regional context, increasing labor specialization, demographic shifts, increased labor mobility and the pursuit of affordable housing are expected to continue the

expansion of home to work journeys among Los Angeles and Orange counties. The increasing need to reduce the travel times of home-work journeys on a regional basis creates a market and a rationale for the development of a high-speed, reliable transportation mode. Increases in population and employment, and increasing distances between jobs and homes, are projected to have a significant adverse effect on freeway congestion levels in coming years.

The majority of key freeways in the region, including the I-5, I-405 and SR-14, are expected to operate at unacceptable levels of congestion and travel speeds (likely to be under 30 miles per hour during a.m. and p.m. commuter travel periods and during many hours on weekends). Loss of productivity, vehicle emissions and other negative factors attributable to travel congestion create the opportunity for an alternative, high-speed travel mode that will promote congestion relief and improve air quality in the region. Daily use of such a system would enable travelers to avoid the delays and stress associated with driving on congested roadways.

Air Travel-Driven Markets

Providing improved airport access, primarily between population and employment centers within and near the Project corridor and Palmdale Airport, is one of the primary benefits of the Orangeline Maglev system. Significant shortfalls are projected in the region's capacity to accommodate growth in both passenger and cargo demands for the five counties served by LAX. Planning for increased airport capacity has centered on the regional context, recognizing that, while LAX will remain the dominant facility for many years to come, Palmdale Airport and other regional airports will be relied upon to absorb demand through future expansion. The market for airport access (for both air travelers and airport employees) could account for 25 percent or more of Orangeline ridership in future years. Air cargo could also be a substantial market opportunity for the Orangeline and thus project designs should accommodate these potential markets.

Constraints

Based on the proposed Maglev system alignment and the system design and functional concepts, the following potential constraints have been identified for evaluation during Phase 1 Preliminary Engineering:

- Vertical and Horizontal Alignment and clearances;
- Airport Operations;
- Geotechnical Factors;
- Environmental and Community Impacts and their Mitigation;
- Freight and Cargo
- Local, Regional, State and Federal Policies.

Next Steps

The next step will be preparation of the Milestone 3 Route Alignment and Station Locations report. Milestone 3 will identify the preferred alignment and station locations. This information will serve as the basis for further preliminary engineering, including development of ridership and revenue estimates, cost estimates and financial plans.

Average and Top Orangeline Maglev Speeds as a Function of Station Spacing

Station Spacing (miles)	Top Speed (mph)	Average Speed (mph)
3	150	75
6	210	110
12	270	150
24	300[1]	195[1]

1 – Top Speed capability of TRI Maglev is about 300 mph. It is anticipated that the Orangeline will likely operate at top speeds of 200 mph or less in dense urban areas.

Station access time is a critical component of overall travel time. Longer station spacing requires more travelers who want to use the maglev system to travel longer distances to access an Orangeline Maglev station, using other modes (bus, light rail, bike, auto, etc.) to reach the Orangeline station. Closer Orangeline maglev station spacing could provide faster travel overall for more passengers, while reducing average maglev speeds somewhat. The introduction of local and express service options could offer the optimum quality service for both short and longer distance travelers.

A preliminary analysis of station-to-station travel times on the Orangeline maglev revealed that, at an average 8-mile station spacing, express service travel time from Palmdale to Irvine is about 48 minutes. By increasing the station stops by 50 percent to an average 5-mile station spacing, local service travel time from Palmdale to Irvine would be 58 minutes, for an increase of 10 minutes. Reducing station spacing would reduce overall trip times for many passengers traveling between intermediate stations. Future ridership studies will identify the best combination of local and express service to maximize ridership and revenues.

The table on the following page provides illustrative data showing travel times between stations for local service that incorporates 30-second station stops and an average 5-mile station spacing.

Orangeline Maglev Local Service

Illustrative Time Profile (With 30 second Station Stops)

	Bakersfield	Lancaster	Palmdale	Santa Clarita	San Fernando	Burbank	Glendale	LA Union Station	Huntington Park	Bell	Vernon	Maywood	South Gate	Cudahy	Downey	Paramount	Bellflower	Cerritos	Artesia	Cypress	Los Alamitos	Stanton	Anaheim	Garden Grove	Santa Ana	Tustin	Irvine	San Diego		
Orangeline Cities*	TIME - MINUTES																												TIME- MINUTES	
Bakersfield	-	25	30	39	44	49	51	56	60	63	63	63	61	64	67	63	66	67	68	70	74	72	75	75	78	81	84	112		Bakersfield
Lancaster		-	5	14	19	25	27	32	36	39	40	40	38	41	44	40	43	45	46	48	52	50	53	53	57	60	64	89		Lancaster
*Palmdale			-	10	15	20	22	27	31	34	35	35	33	36	38	35	38	39	41	43	47	45	48	48	52	55	58	84		*Palmdale
*Santa Clarita				-	6	12	15	21	25	28	29	29	27	31	34	30	33	35	37	39	44	42	45	45	49	52	56	76		*Santa Clarita
San Fernando					-	6	9	15	19	22	23	23	21	24	28	24	27	29	31	33	38	36	39	39	43	46	50	70		San Fernando
Burbank						-	3	11	13	27	17	17	2	18	19	18	21	23	25	27	32	30	33	33	37	40	44	64		Burbank
Glendale							-	11	10	22	15	15	12	16	17	16	18	20	22	24	29	27	31	30	34	38	41	62		Glendale
LA Union Station								-	4	9	9	9	7	10	13	10	10	15	17	19	24	22	25	25	29	32	35	57		LA Union Station
*Huntington Park									-	5	7	7	3	7	10	6	6	9	13	15	21	18	21	21	25	29	32	53		*Huntington Park
*Bell										-	5	5	7	5	14	10	12	13	16	19	25	22	27	25	29	32	35	56		*Bell
*Vernon											-	5	9	11	16	11	13	17	17	17	26	24	27	27	30	33	36	57		*Vernon
*Maywood												-	9	10	16	10	14	17	16	17	24	24	27	27	30	33	36	57		*Maywood
*South Gate													-	5	7	3	6	8	10	13	16	15	19	19	22	26	29	51		*South Gate
*Cudahy														-	8	7	10	12	14	16	22	19	19	23	26	29	33	54		*Cudahy
*Downey															-	5	7	10	12	14	22	16	16	20	23	26	30	52		*Downey
*Paramount																-	3	6	10	9	17	13	16	16	15	23	26	48		*Paramount
*Bellflower																	-	3	5	7	14	10	13	13	12	17	23	45		*Bellflower
*Cerritos																		-	3	4	11	7	10	10	14	14	17	44		*Cerritos
*Artesia																			-	3	16	10	14	13	17	20	20	48		*Artesia
Cypress																				-	7	3	6	6	10	13	17	41		Cypress
*Los Alamitos																					-	9	12	12	15	18	21	45		*Los Alamitos
Stanton																						-	3	3	7	11	14	40		Stanton
Anaheim																							-	10	5	6	9	42		Anaheim
Garden Grove																								-	4	7	11	37		Garden Grove
Santa Ana																									-	3	7	34		Santa Ana
Tustin																										-	3	31		Tustin
Irvine																											-	30		Irvine
San Diego																												-		San Diego