Guam Islandwide Program Management Services

Task Order No. 1A

PB DPW FHWA- GU-NH-IPMS (002)

2030 GUAM TRANSPORTATION PLAN

December 19, 2008

The Government of Guam
Department of Public Works

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2030 Guam Transportation Plan

Government of Guam
Department of Public Works

Prepared with financial assistance from
the Federal Highway Administration

Governor Felix P. Camacho
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Acronyms

AAFB	Andersen Air Force Base
AASHTO	American Association of State Highway Transportation Officials
AC	advance construction
ADA	Americans with Disabilities Act
ADT	average daily traffic
BEQ	bachelor enlisted quarters
BMD	ballistic missile defense
CatEx	categorical exclusion
CNMI	Common wealth of the Northern Mariana Islands
COP	community outreach plan
CY	calendar year
DAR	defense access road
DOPAA	Description of the Proposed Action and Alternatives
DOT	Department of Transportation
DPW	(Guam) Department of Public Works
E+C	existing + committed
EA	environmental assessment
EB	eastbound
EIS	environmental impact statement
ER	emergency relief program
ESAL	equivalent single axel load
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
FY	fiscal year
GARVEE	Grant Anticipation Revenue Vehicle
GCA	Guam Contractors Association
GDPW	Government of Guam Department of Public Works
GHMP	Guam Highway Master Plan
GIPMS	Guam Islandwide Program Management Services
GIS	geographic information system
GovGuam	Government of Guam
GPD	Guam Police Department
GTP	2030 Guam Transportation Plan
HRN	Haul Road Network
IMPS	Islandwide Program Management Services
ISTEA	Intermodal Surface Transportation Act
IWG	Interagency Working Group
JARC	Job Access and Reverse Commute Program
JGPO	Joint Guam Program Office
LOS	level of service
MPO	Metropolitan Planning Organization
MUTCD	Manual of Uniform Traffic Control Devices
NAVCAMS Barrigada	Naval Communications Station

NAVFAC	Navy Facilities
NAVFACMAR	Naval Facilities Marianas Islands
NB	northbound
NCTS Finegayan	Naval Computer and Telecommunication Station
NEPA	National Environmental Policy Act
NHS	National Highway System
NTD	Federal Transit Administration National Transit Database
O&M	operations and maintenance
OA	obligation authority
OEIS	overseas environmental impact statement
OHS	Department of Public Works—Office of Highway Safety
RTA	Rural Transit Assistance
SAFETEA-LU	Safe Accountable Flexible Efficient Transportation Equity Act—A Legacy for Users
SB	southbound
SDDC	Surface Deployment and Distribution Command
TDB	transportation demand management
TEA-21	Transportation Equity Act for the 21st Century
THP	Territorial Highway Program
THS	Territorial Highway System
TIFIA	Transportation Infrastructure Finance and Innovation Act
TLUC	Territorial Land Use Commission
TPPP	transit public private partnerships
TSM	transportation system management
TTIP	Territorial Transportation Improvement Plan
U.S.	United States
USC	United States Code
USDOD	United States Department of Defense
USDOT	United States Department of Transportation
USMC	United States Marine Corps
v/c	volume-to-capacity
VHD	vehicle hours of delay
VHT	vehicle hours traveled
VMT	vehicle miles traveled
WB	westbound

EXECUTIVE SUMMARY

The *2030 Guam Transportation Plan* (GTP) presents a comprehensive, long-term strategy to improve transportation infrastructure and operations throughout Guam. The Government of Guam, through its Department of Public Works (GDPW) and Department of Administration, Division of Public Transportation Services, and the Federal Highway Administration (FHWA), as well as the Federal Transit Administration (FTA), have partnered to prepare this plan. The plan addresses Guam's anticipated multimodal transportation needs, including roadway, bicycle, pedestrian, and transit facilities. The GTP includes forecasts for population, employment, and traffic growth through the year 2030, including impacts associated with the potential U.S. Department of Defense (USDOD) multiple services build-up. Sustainable financing and project implementation recommendations are also included in the plan.

Development of the GTP was guided through an extensive community outreach effort. Two major series of public meetings were held throughout Guam during February and October 2008. Members of the public were encouraged to identify existing issues and needs, review and comment on proposed transportation improvements, and develop new ideas for solutions. Meetings were also held with village mayors, civic and business groups, and a range of federal agencies.

The plan builds upon the vision, goals, and objectives for the future Guam transportation system. The vision statement for the GDPW is "to provide a safe, efficient and sustainable transportation system for our residents, visitors, and military personnel that supports economic diversification, resource conservation, and an exceptional quality of life." The GTP goals identified through the public and agency coordination effort, which are fully described in Chapter 2, What Is the Vision?, include the following:

- Safety
- Integrated transportation and land use
- Accessibility, mobility, and intermodal connectivity
- System and services efficiency
- Environmental and resource conservation
- Economic diversification and vitality
- Communication and collaboration
- Program and project funding
- Title VI civil rights and environmental justice
- System preservation and maintenance
- System security

S.1 Existing Conditions

Chapter 3, Existing Demographic and Transportation Conditions, describes the existing conditions on Guam, including land use, population, employment, tourism, traffic, and multimodal transportation facilities. Guam contains 19 villages, with the most heavily

urbanized areas located at Hagatna, Agana Bay, and Tamuning. Large public uses include military bases, which comprise about 39,000 acres, and the Guam National Wildlife Refuge. Villages are shown in Figure S-1 and current population is shown in Figure S-2.

Population on the island has increased steadily since 1950 and reached 175,877 residents in 2008. The majority of this population is concentrated in the central and northern areas of Guam. Employment growth has been driven by the tourism industry and military uses. Employment growth has been steady since 2001, with approximately 65,000 jobs on Guam in 2008. Job growth has been affected by external issues such as military investments, global economic trends, and natural disasters in the region. Service, professional, and other non-military employment is concentrated in the central areas of Tamuning/Tumon and Hagatna. Military jobs are concentrated in the northern and southwestern parts of the island. Tourism generates substantial economic activity on Guam, with almost 1.2 million visitors in 2007. The majority of tourists are from Japan.

Figure S-1: Villages

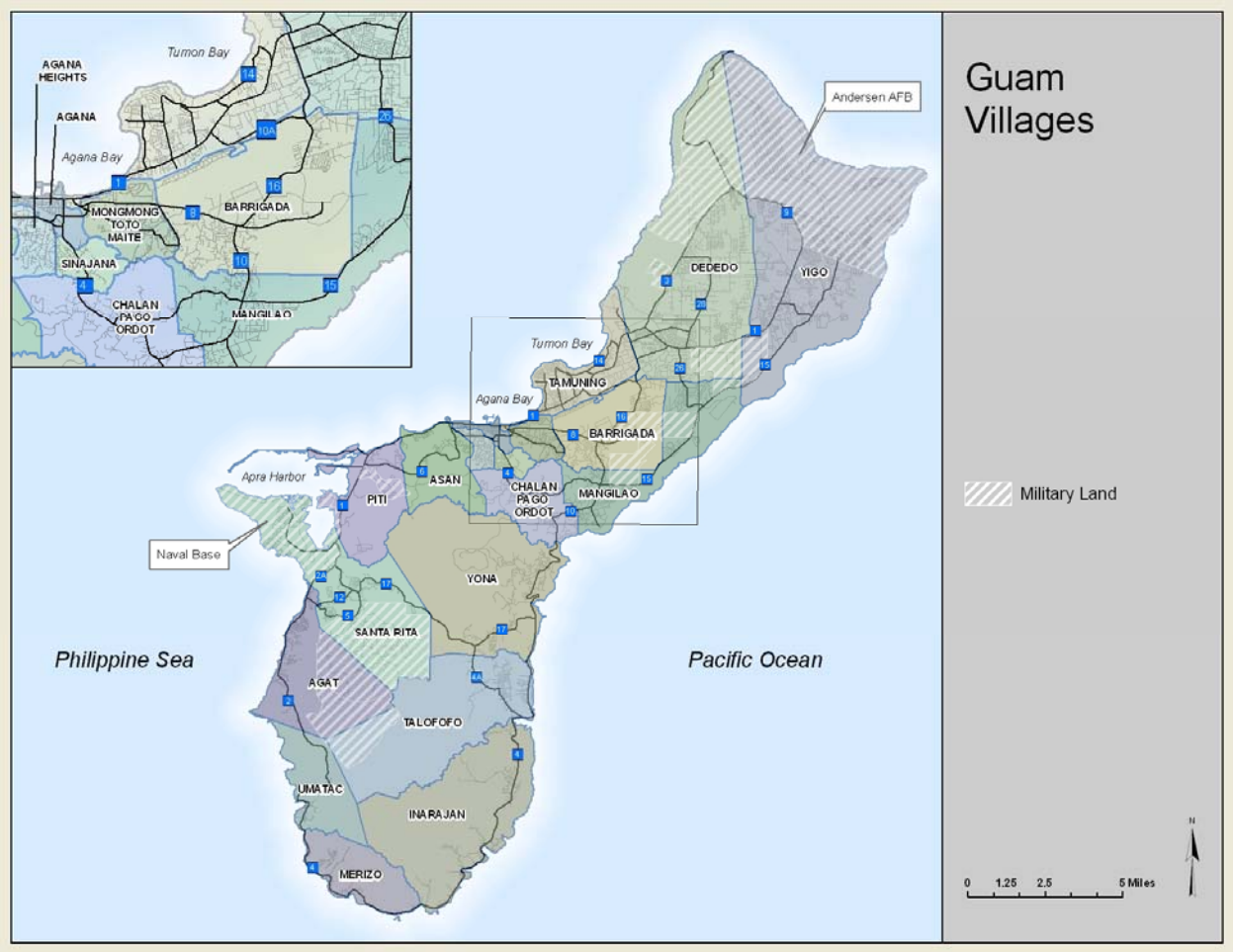
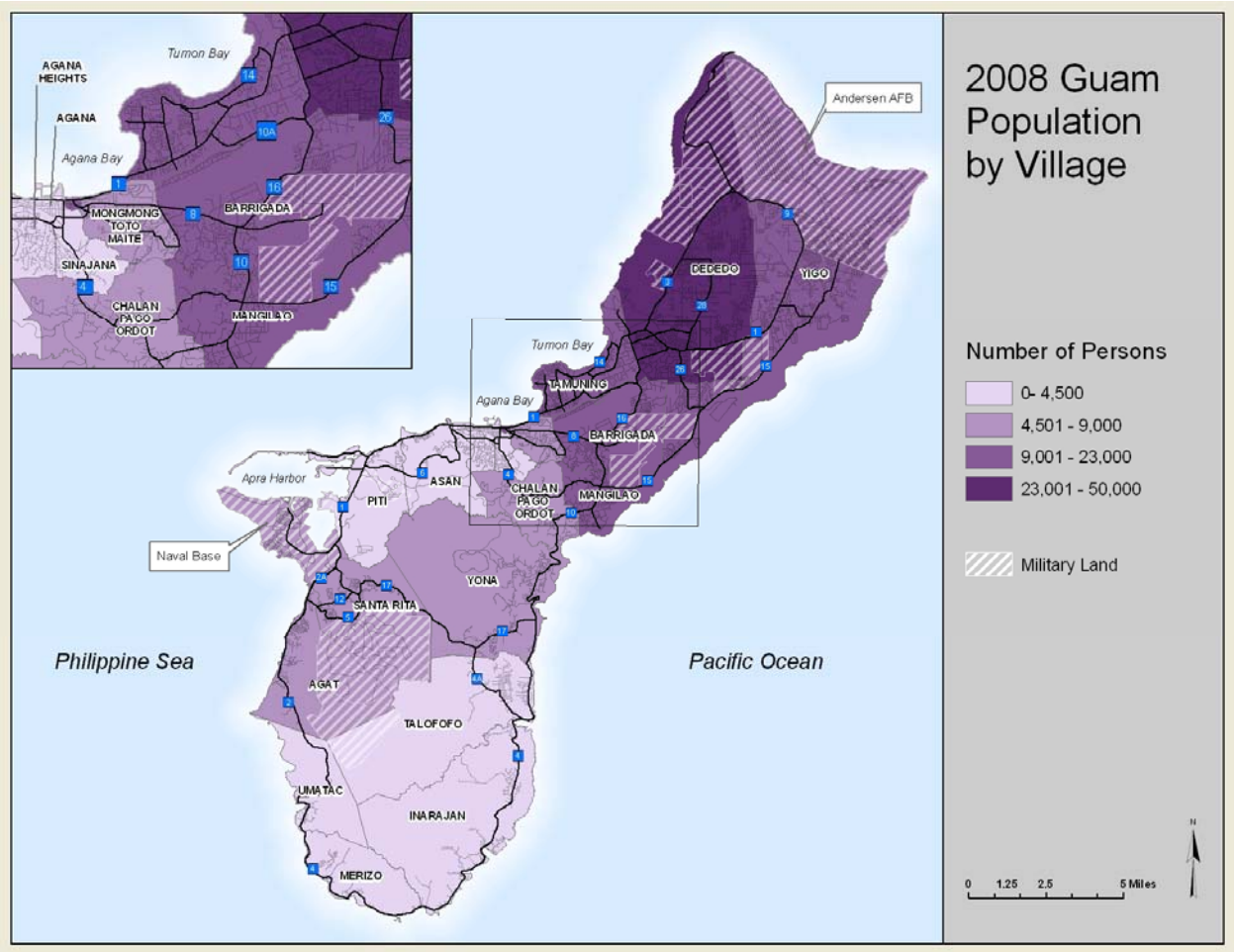


Figure S-2: Population (2008)



S.1.1 Transportation Facilities

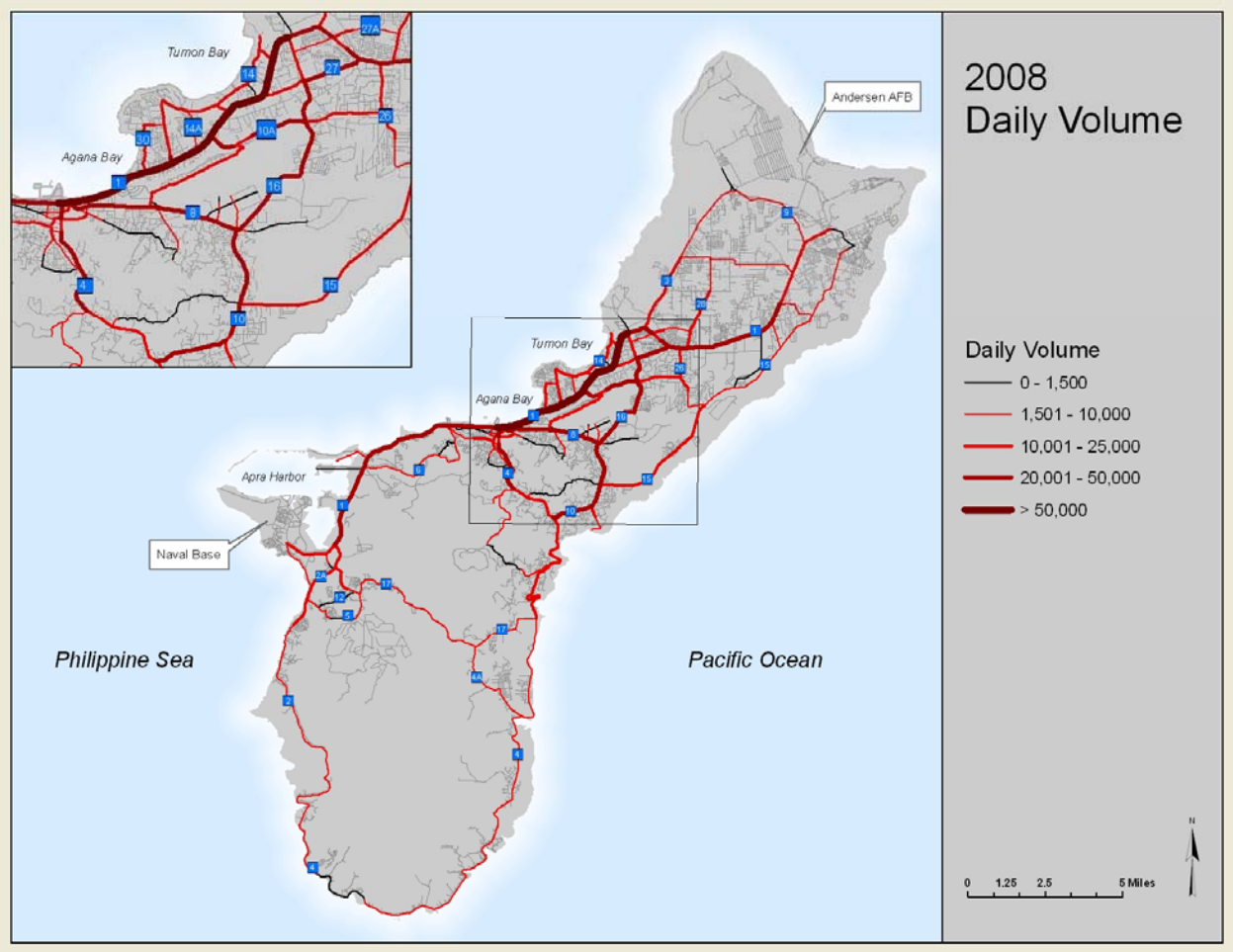
The existing transportation network includes roadways, bridges, transit, sidewalks, other bicycle and pedestrian facilities, harbors, and airports. The GDPW maintains a roadway network with 155 miles of federal-aid highways and 860 miles of other roadways. In addition to roadways, GDPW maintains 36 bridges throughout the island. An FHWA bridge inspection program indicated that eight bridges are in immediate need of repair or replacement. Many existing roadways require maintenance, such as repaving, signage, pavement markings, or lighting. The condition of existing roadways varies from acceptable (with no major safety or geometric concerns) to poor (minor safety issues, geometric issues, or pavement disrepair) and unacceptable (major alignment, safety, or pavement repair issues). A summary of road conditions by major highway is provided in Table S-1.

Table S-1: Characteristics of Major Highways on Guam

Route #	South/West Terminus (Municipality)	North/East Terminus (Municipality)	# of Lanes	Speed Limit (mph)	Length (miles)	Pavement Condition
1	Santa Rita	Yigo	4/6	35/45	22	Varies
2	Umatac	Santa Rita	2/3	15/25/35	10	Poor
2a	Santa Rita	Santa Rita	2/4	35	1.8	Poor
3	Dededo	Dededo	2/4	35/45	5.7	Acceptable
3a	Dededo	Yigo	2	None Posted	6.1	Poor
4	Umatac	Hagatna	2/6	15/25/35	24.4	Unacceptable
4a	Talofofo	Yona	2	15/35	2.4	Poor
5	Agat	Santa Rita	2	35	1.1	Acceptable
6	Piti	Asan	2/4	25/35	4.8	Poor
7	Asan	Hagatna	2	25/35	0.8	Unacceptable
7a	Hagatna	Hagatna	2/3	15/25	0.16	Unacceptable
7b	Hagatna	Hagatna	2	None Posted	0.2	Unacceptable
8	Hagatna	Barrigada	4	35/45	4.3	Poor
9	Dededo	Yigo	2	35	3.1	Acceptable
10	Chalan-Pago-Ordot	Barrigada	2/4	25/35	3.2	Poor
10a	Tamuning	Barrigada	2/4	25/35	1.9	Unacceptable
11	Piti	Piti	2	35	2.9	Acceptable
12	Agat	Santa Rita	2	25	2.7	Poor
14	Tamuning	Tamuning	2/6	25/35	3.9	Acceptable
14a	Tamuning	Tamuning	2	None Posted	0.2	Acceptable
14b	Tamuning	Tamuning	4	None Posted	0.8	Unacceptable
15	Chalan-Pago-Ordot	Yigo	2	15/N.P.	14.2	Poor
16	Barrigada	Barrigada	4/6	35/N.P.	3.9	Poor
17	Santa Rita	Yona	2	25/35	7.4	Unacceptable
18	Piti	Piti	2	None Posted	1.4	Acceptable
26	Mangilao	Dededo	2	35	2.3	Unacceptable
27	Dededo	Dededo	6	35	1.1	Poor
27a	Dededo	Dededo	2	None Posted	2	Acceptable
28	Dededo	Dededo	2	35	3.9	Poor
29	Yigo	Yigo	2	25	1.2	Unacceptable
30	Tamuning	Tamuning	3/4	25	1.3	Acceptable
30a	Tamuning	Tamuning	4	25	0.6	Acceptable
32	Mangilao	Mangilao	2	None Posted	0.6	Acceptable
33	Hagatna	Barrigada	2	15	2.2	Unacceptable
34	Dededo	Tamuning	2	None Posted	3.6	Acceptable

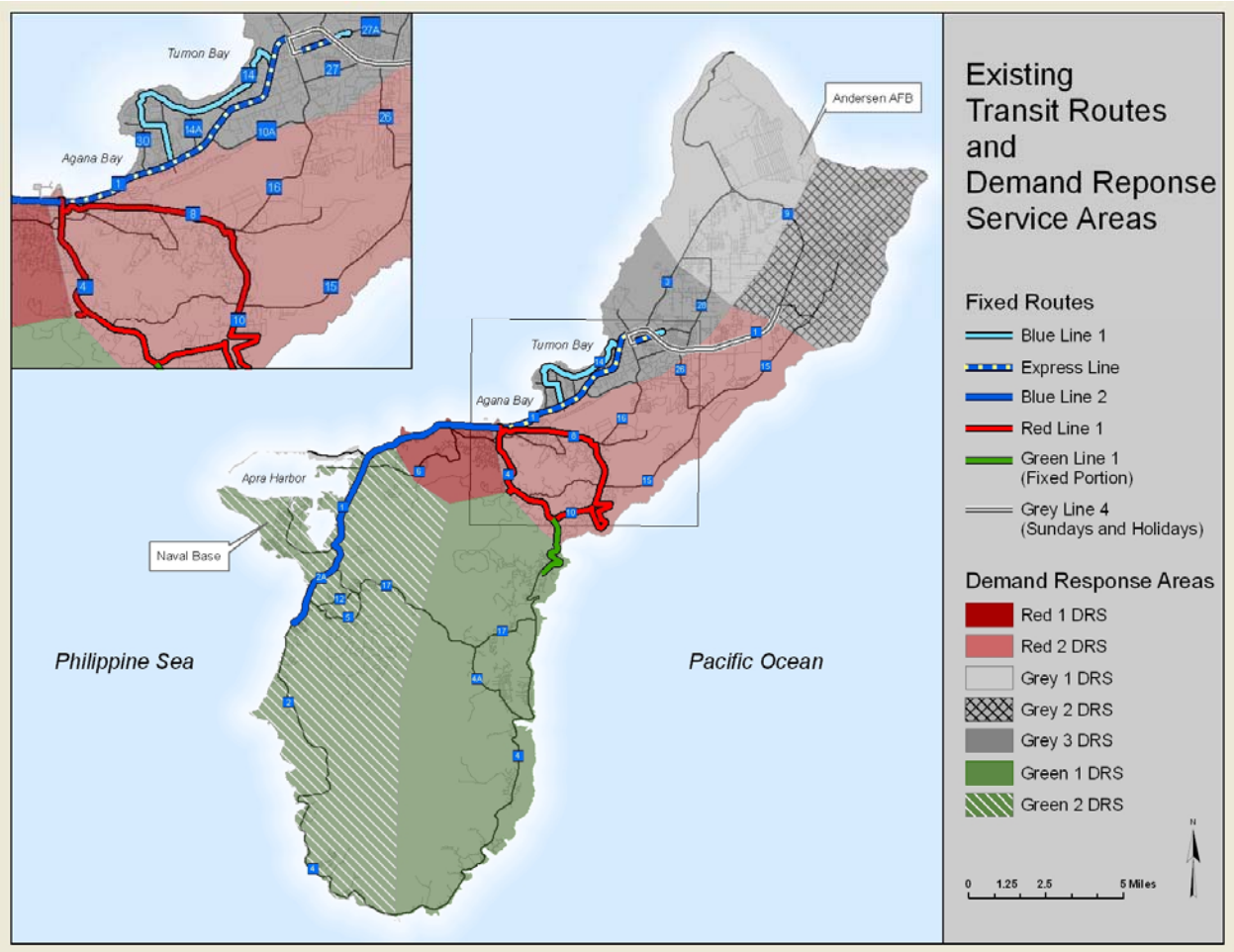
Traffic levels on Guam appear to be increasing. Between 2003 and 2008, traffic on Routes 1, 2, 3, 10, 14, and 16 increased from 20 to 80 percent. Patterns of traffic congestion in 2008 are shown in Figure S-3. The most heavily congested routes include Routes 27, 27a, and 28 in Dededo, Route 29 in Yigo, Route 10a in Tamuning/Barrigada, Route 2 in Agat, and Route 4 in Yona. In addition to lack of roadway capacity, poorly timed traffic signals contribute significantly to roadway congestion.

Figure S-3: Average Daily Traffic (2008)



The Guam Department of Administration—Division of Mass Transit provides fixed-route, demand-response, and paratransit service. Fixed-route bus service is a system of regularly scheduled bus routes. Demand-response service provides service by reservation to activity centers or areas with fixed-route service. Paratransit is a service for the disabled. Six fixed-route lines are offered and serve the major urban areas as shown in Figure S-4. While this service enhances the mobility of Guam residents, schedules are in many cases not well matched to actual bus travel times resulting in a lack of predictability and poor service for transit customers. Based on the population and employment characteristics of the region, it is anticipated that improvements to scheduling and the use of additional transit vehicles could substantially increase transit ridership.

Figure S-4: Existing Transit Routes



Limited facilities are available for bicyclists and pedestrians. Sidewalks exist along some roadways in urban areas (26 linear miles in total), and all 78 signalized intersections provide for pedestrian crossings. However, no designated bicycle lanes or paths are available. Bicyclists and pedestrians typically use the road shoulder when no other accommodations are available. Responses at public meetings indicated widespread support for enhanced pedestrian and bicycle facilities.

Guam is home to the Apra Harbor deep water port, which is used by the U.S. Navy as well as private commercial interests. The 500-yard-wide, 100-foot-deep entrance to the harbor faces west into the Philippine Sea. Operated by Port Authority Guam, the commercial port handles about 2 million tons of cargo each year. The cargo facilities accommodate containerized, unitized, break-bulk, and tuna cargo. Modernization of the port is proposed in the *2030 Port of Guam Master Plan.* The primary intermodal connection point is Route 11, which connects to Route 1. Apra Harbor will be the key location from which construction materials and equipment are transported for the military construction activity planned between 2009 and 2014.

Guam has two active airports: Antonio B. Won Pat International Airport and North Field on Andersen Air Force Base. Antonio B. Won Pat International Airport is located in Guam's

most active business district and provides a roadway connection to Route 10a. This airport has an average of 48 flights per day and also includes cargo and freight operations.

S.1.2 Safety Programs

The Department of Public Works—Office of Highway Safety (OHS) administers a comprehensive highway safety plan to reduce crashes on Guam's roadways. OHS directs public information campaigns designed to improve passenger safety and is instrumental in securing funding for roadway safety improvements. Accident data collection resources are limited, with no central data repository for use by multiple law enforcement and other local agencies. The Guam Homeland Security Office of Civil Defense is responsible for managing emergency preparedness and response efforts on the island. The Department of Administration—Division of Public Transportation Services has also developed a program for addressing safety and security for the transit system.

S.2 Future Demographic and Transportation Conditions

Historic trends in population and employment growth are expected to continue through the year 2030. The natural rates of growth will be compounded by the proposed USDOD military expansion on Guam. Without the anticipated military build-up, the 2008 population of 176,000 would be expected to grow 26 percent to 222,000 by 2030. With the military build-up, population is expected to increase 44 percent to 253,000.

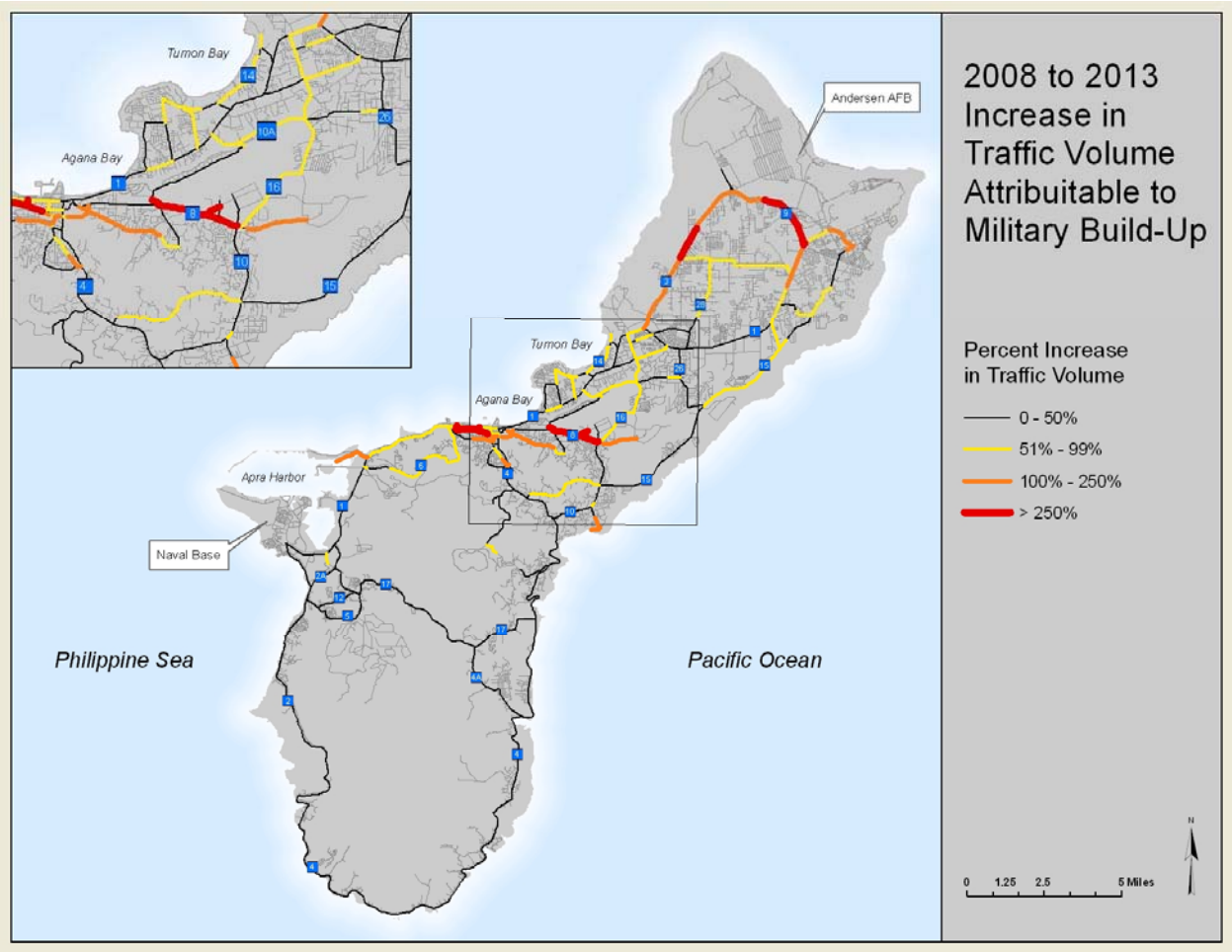
It is expected that the military build-up will have a strong, positive impact on employment. The current unemployment rate of 11 percent is projected to decrease to 4 percent in 2013 as a result of military employment, construction jobs, and indirect jobs in supporting industries. In 2013, the year of peak military construction, 15,900 construction jobs, 20,100 indirect jobs, and 250 civilian USDOD jobs are anticipated.

Future travel demand is expected to increase as a result of the dramatic population and employment growth. In addition, construction of the new military facilities will greatly increase the amount and frequency of heavy truck traffic on the road network. These heavy vehicles will also cause more rapid deterioration of roadway facilities. The military truck traffic will also increase for the Marine relocation, including the transport of military supplies from the port to various military installations.

A series of traffic scenarios were analyzed to track the impact of these changes on roadway performance and level of service. These scenarios include the 2008 Baseline, 2013 Baseline, 2030 Baseline, 2013 Military Expansion Construction Peak, and 2015 Military Expansion Military Build-up. The analysis included the existing roadway network and transportation improvements that are already funded in the Territorial Transportation Improvement Program (TTIP).

Traffic analysis indicates that conditions on Guam roadways will significantly deteriorate during the military construction period. Key roadways will experience an increase in traffic volume of over 50 percent. As shown in Figure S-5, highway segments south of Andersen Air Force Base and in the heart of the urbanized areas of the central island will experience a traffic increase of between 100 percent and 250 percent as a result of the military build-up.

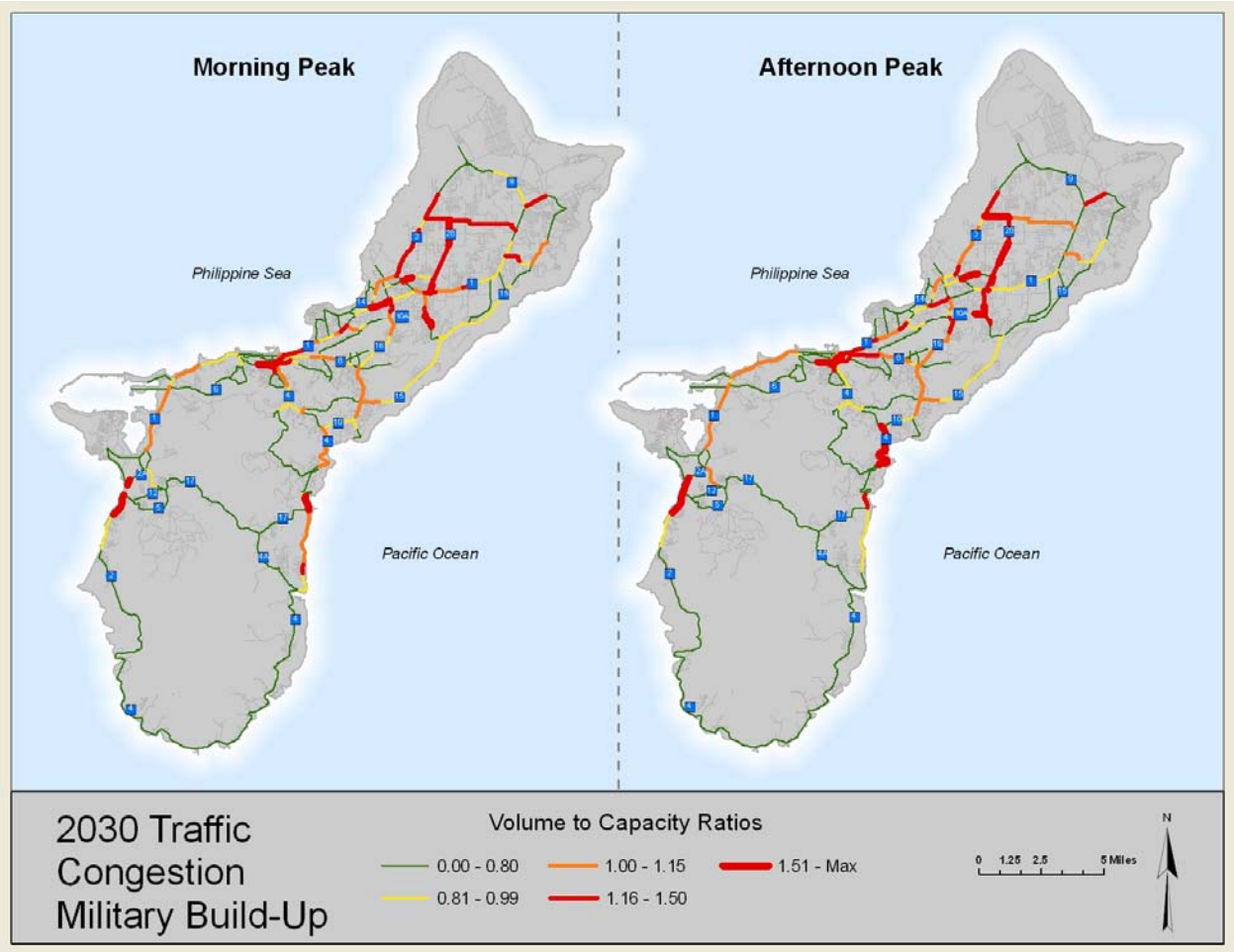
Figure S-5: Traffic Increases Attributable to the Military Build-up (2013)



By 2030, traffic congestion is expected to be severe on major roads serving both military and tourist areas. As shown in Figure S-6, major corridors that will experience traffic congestion include the following:

- Dededo—Routes 28, 27a, 26, and 25
- Tamuning—Route 27a Extension to Route 1 (Hamburger Highway)
- Agat—Route 2
- Chalan Pago and Yona—Route 4

Figure S-6: Congestion Levels (2030)



S.3 Needs Assessment

The program of multimodal improvements recommended in this GTP is designed to meet the long-term, multimodal transportation needs of Guam. The priority of the GDPW is to maintain, preserve, and enhance Guam's existing transportation system. To do so, the first priority projects will include bridge replacements, geometric road improvements, pavement repair, intersection improvements, and traffic signal enhancements. Congestion-related improvements will also be required to maintain reasonable levels of service on the roads during peak hours and throughout the day. Improvements to enhance multimodal transportation options are also included, such as transit, bicycle, and pedestrian facilities.

Performance measures were developed to evaluate and prioritize alternative improvements. These measures will be used to aid in the selection of projects for inclusion in the TTIP. Performance measures include safety, protection of existing facilities, reduction of traffic congestion, external requirements, promotion of economic development, availability of non-GDPW funding, population served by the improvement, relation to adopted plans, and timeliness.

S.3.1 Roadway Improvements

A variety of roadway improvement types are recommended, including development of the Haul Road Network (HRN), increase in road capacity, rehabilitation of existing roadways, intersection improvements, bridge improvements, and village street improvements.

The HRN is critically needed to accommodate the heavy military truck and construction traffic anticipated when the United States 3rd Marine Corps Expeditionary Forces Air Combat Element, Command Element, Ground Combat Element, and Command Service Element will relocate from Japan to Guam. The anticipated population, employment, and traffic impacts are documented in Section S.4. The HRN program involves improving the routes to be used by the military for primary heavy vehicle traffic. This series of priority roads for the military connects such key locations as the Port of Guam, Smith Rock Quarry, Andersen Air Force Base, and the NCTS Finegayan and South Finegayan Sites. It is assumed that the military will fund the projects required for operation of the HRN. A map and list of projects in the HRN are provided in Figure S-7 and Table S-2.

Figure S-7: Haul Road Network

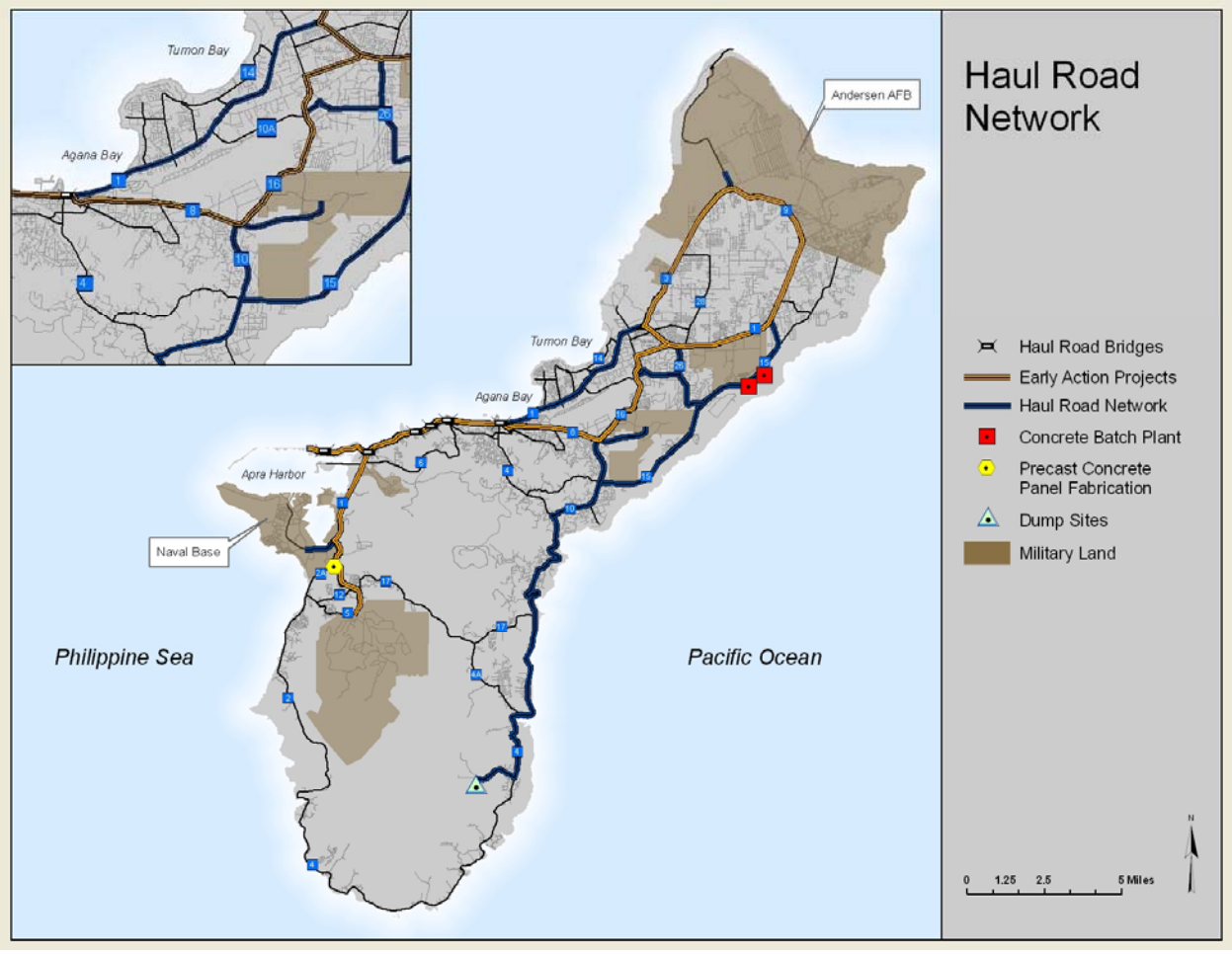


Table S-2: List of Haul Road Network Projects

Route	Segment Limits	Requirements/Comments
1	Route 1/Route 8	Intersection Improvements (.15 mile on Route 1 and .09 mile on Route 8)
1	Route 1/Route 3	Intersection Improvements (.24 mile on Route 1 and .04 mile on Route 3)
1	East of Route 4	Agana Bridge Replacement
1	Route 27 to Chalan Lujuna	Pavement strengthening (four lanes)
1	Route 3 to Route 27	Pavement strengthening (six lanes)
1	Route 11 to Asan River	Pavement strengthening (four lanes)
1	Asan River to Route 6	Pavement strengthening (four lanes)
1	Route 6 (Adelup) to Route 4	Pavement strengthening (six lanes)
1	Chalan Lujuna to Route 9 (AAFB)	Pavement strengthening (four lanes)
1	Route 11 to Route 2a	Pavement strengthening (four lanes)
1	Route 8 to Route 3	Pavement strengthening (six lanes)
3	Route 28 to Route 1	Pavement strengthening (four lanes)
3	NCTS Finegayan to Route 28	Pavement strengthening, widen from two lanes to four lanes, add and shoulders
3	NCTS Finegayan to Route 9	Pavement strengthening (two lanes), add median and shoulders
5	Route 2a to Route 17	Pavement strengthening (two lanes)
5	Route 17 to Naval Ordnance	Pavement strengthening (two lanes)
8	Tiyan Parkway/Biang Street to Route 1	Pavement strengthening (four lanes)
8	Route 10 to Tiyan Pkwy/Biang Street	Pavement strengthening (four lanes)
8	Route 16 to NAVCAMS Barrigada	Pavement strengthening (two lanes)
9	Route 3 to Route 1 (AAFB)	Pavement strengthening (two lanes), add median and shoulders
10	Route 15 to Routes 8 and 16	Pavement strengthening (four/six lanes)
10	Route 15 to Route 4	Pavement strengthening (four lanes)
11	Port to Intersection with Route 1	Rehabilitate two Lanes
11	Route 1/Route 11	Intersection improvements (.12 mile on Route 1)
15	Smith Quarry to Chalan Lujuna	Pavement strengthening (two lanes), safety/operational improvements
15	Route 10 to Connector (Chalan Lujuna end)	Pavement strengthening (two lanes)
16	Route 27 to Route 10a	Pavement strengthening (six lanes)
16	Route 10a to Sabana Barrigada Drive	Pavement strengthening (four lanes)
16	Sabana Barrigada Drive to Routes 8 and 10	Pavement strengthening (four lanes)
27	Route 1 to Route 16	Pavement strengthening (six lanes)
2a	Route 1 to Route 5	Pavement strengthening (four lanes)
Chalan Lujuna	Route 1 to Route 15	Pavement strengthening (two lanes), Turning lane and intersection improvements for trucks

* Description of Proposed Action and Alternatives Data Sheets will not be in the ROADS section. These projects will be part of their respective master planned component.

Tier I Congestion-Related Projects address areas with severe traffic congestion today or that are expected to experience high levels of traffic congestion in the future. Safety and operational improvements for these corridors include road widenings, construction of additional turn lanes, raised medians for access control, and shoulders and sidewalks.

The recommended Tier I Congestion-Related Projects are shown in Figure S-8 and Table S-3.

Figure S-8: Tier I Congestion-Related Improvements

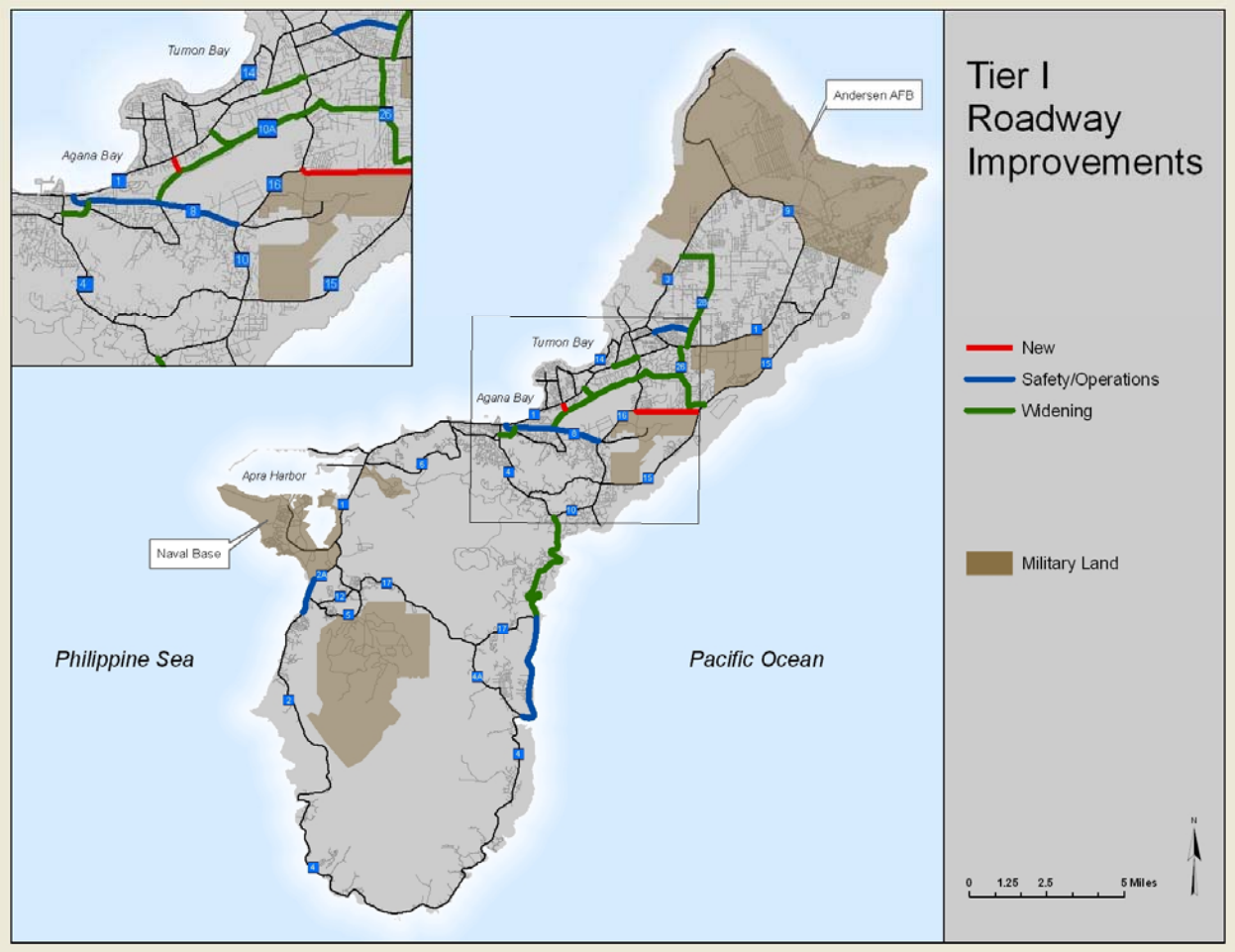


Table S-3: Tier I Congestion-Related Improvements

Project Name	Project Limits	Project Description	Length (miles)	2008 Volume (vpd)	Peak Hour Congestion*		Safety		
					2008	2030	Fatals	Injury	Rate**
Tijan Parkway	Route 10a to Route 8	Widen from two to four lanes/sidewalks	2.65	13,700	N	M	0	24	4.53
Route 14 Extension	Route 1 to Tiyan Parkway	New four-lane connection	0.60	NA	M	M	NA	NA	NA
Route 28	Route 3 to Route 1	Widen from two to four lanes/sidewalks	3.90	12,500	M	S	1	93	13.4
Route 8	Route 1 to Route 10	Safety/operational improvements	3.14	37,700	N	M	3	155	9.38
Route 4	Route 10 to Route 17	Widen from two to four lanes/sidewalks	2.70	18,300	M	S	1	82	11.7
Route 4	Route 17 to Route 4a	Safety/operational improvements	5.80	8,100	N	M	1	40	6.18
Route 2	Route 2a to Erskin Dr	Safety/operational improvements	1.16	17,300	S	S	2	44	16.7
Route 27 Extension (Hamburger Highway)	Route 16 to Route 1	Widen from two to four lanes/sidewalks	0.80	13,800	M	S	NA	NA	NA
Route 27a	Route 1 to Route 28	Safety/operational improvements	1.20	9,500	S	S	0	8	4.81
Route 25	Route 16 to Route 26	Widen from two to four lanes/sidewalks	1.40	15,600	S	S	0	24	7.53
Route 26	Route 1 to Route 15	Widen from two to four lanes/sidewalks	2.54	14,000	N	S	0	119	22.9
Adacao Connection	Route 16 to Route 15	New two-lane connection/turn lane/shoulders	2.06	NA	M	M	NA	NA	NA
Route 7a	Route 8 to Route 4	Widen from three to four lanes	0.60	15,000	N	S	0	20	15.2

NA = Not Applicable
*S = Severe, M = Moderate, N = None
**Rate = weighted number of crashes per million miles of travel

Tier II Congestion-Related Improvements are intended for implementation after the Tier I projects and address travel needs on roadways that will experience moderate traffic congestion in 2030. These projects also include road widenings, safety and operational improvements, additional through and turn lane, raised medians, and sidewalks and shoulders. Tier II Congestion-Related Improvements are shown in Figure S-9 and Table S-4.

Figure S-9: Tier II Congestion-Related Improvements

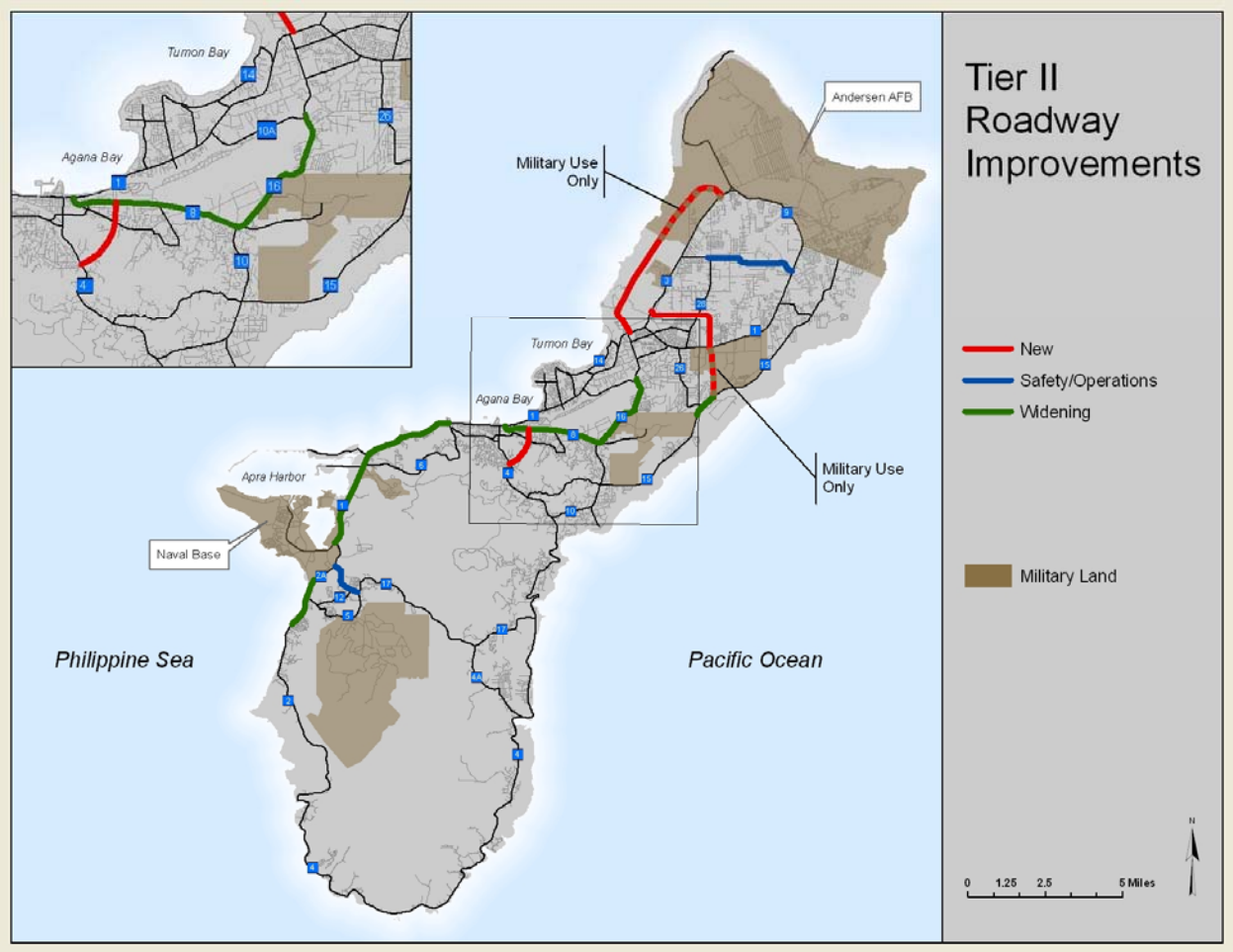


Table S-4: Tier II Congestion-Related Improvements

Project Name	Project Limits	Project Description	Length (miles)	2008 Volume (vpd)	Peak Hour Congestion*		Safety		
					2008	2030	Fatals	Injury	Rate**
Route 8	Route 1 to Route 10	Widen from four/six to six lanes	3.14	37,700	N	M	3	155	9.38
Route 16	Route 10a to Route 10	Widen from four to six lanes	2.65	37,300	N	M	3	124	9.09
Finegayan Connection	Route 1 to Route 3	New two-lane connection/turn lane/ shoulders	2.51	N/A	N	M	N/A	N/A	N/A
Okkodo Connection	Finegayan to Route 28	New two-lane connection/shoulders	2.29	N/A	N	M	N/A	N/A	N/A
Okkodo Connection	Route 28 to Route 1	New two-lane connection/turn lane/ sidewalk	1.42	N/A	N	M	N/A	N/A	N/A
MogFog Connection	Route 1 to Route 15	New two-lane connection/turn lane/ shoulders	1.64	N/A	N	M	N/A	N/A	N/A
Koda/Nijok/Mataguac	Route 28 to Route 1	Safety/operational improvements	2.93	2,300	N	S	N/A	N/A	N/A
Ordot-Mongmong Connection	Route 8 to Route 4	New two-lane connection/turn lane/ shoulders	1.49	N/A	N	M	N/A	N/A	N/A
Route 5	Route 2a to Route 17	Safety/operational improvements	1.26	11,800	N	M	0	22	10.1
Route 2	Route 2a to Erskin Dr	Widen from two to four lanes/ shoulders	1.28	17,300	S	S	2	44	15.1
Route 1	Route 6 (Adelup) to Route 11	Widen from four to six lanes	2.90	35,900	N	M	2	46	3.34
Route 1	Route 11 to Route 2a	Widen from four to six lanes	3.10	31,100	N	M	1	63	4.65
Route 15	Adacao to MogFog	Widen from two to four lanes/ shoulders	0.72	15,100	N	M	0	17	10.7

NA = Not Applicable
*S = Severe, M = Moderate, N = None
**Rate = weighted number of crashes per million miles of travel

Rehabilitation or reconstruction improvements are needed to address the remainder of Guam's federal-aid road network that will not be widened as part of the Tier I or Tier II capacity improvement projects or in the HRN. These improvements typically include milling and overlaying existing roads to improve the paved surface and replacement of damaged concrete sidewalks, curbs, and gutters. Rehabilitation projects may also include minor safety enhancements and upgrades to signage and pavement markings. Reconstruction projects include all upgrades necessary to bring a facility to current FHWA or GDPW standards. Needed rehabilitation improvements are shown in Figure S-10 and Table S-5.

Figure S-10: Rehabilitation Improvements

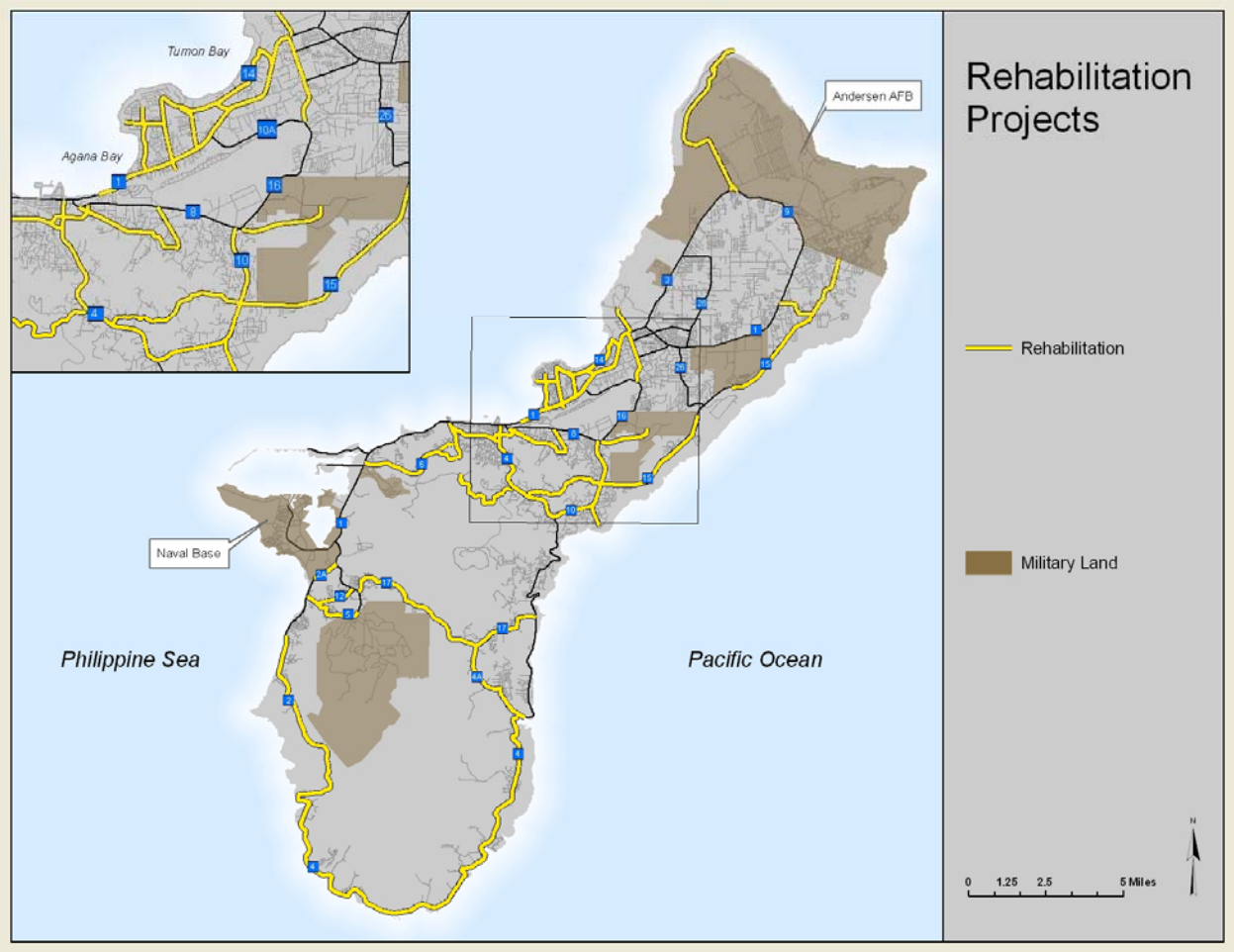


Table S-5: Rehabilitation Improvements

Project Name	Project Limits	Project Description	Length (miles)	2008 Volume	Peak Hour Congestion*		Safety		
					2008	2030	Fatal Accidents	Injury	Rate
Route 1	Route 3 to Route 8	Rehabilitate six lanes	5.93	67,500	S	M	7	1100	19.1
Route 3a	Route 3 to End	Rehabilitate two lanes/shoulders	6.10	100	N	N	0	1	11.2
Route 34	Route 1 to Two Lovers Point	Rehabilitate two lanes/shoulders	3.60	1,000	N	N	0	5	9.51
Route 29	Route 1 to Route 15	Rehabilitate two lanes/shoulders	1.20	8,200	M	M	0	33	23
Route 15	AAFB to Route 10	Rehabilitate two lanes/shoulders	11.41	8,500	N	N	2	97	7.19
Route 15 (Dairy)	Route 4 to Route 10	Rehabilitate two lanes/shoulders	2.79	1,000	N	N	1	14	40.3
Route 16	Route 1 to Route 27	Rehabilitate four lanes	3.90	24,000	N	M	1	174	12.9
Route 14	Route 1 to Route 1 (ITC)	Rehabilitate four lanes	3.90	18,500	N	N	4	525	50.8
Route 14a	Route 14 to Route 1	Rehabilitate two lanes	0.20	18,200	N	N	0	23	43.3
Route 14b	Route 14 to Route 1	Rehabilitate two lanes/sidewalks	0.80	4,300	N	N		24	47.8
Route 30	Route 1 to End	Rehabilitate two lanes/sidewalks	1.30	16,300	N	N	0	32	10.3
Route 30a	Route 14 to End	Rehabilitate four lanes	0.60	13,800	N	N	0	27	22.3
Route 8	Route 16 to End	Rehabilitate two lanes/shoulders	1.16	1,400	N	N	0	6	25.3
Route 32	Route 10 to End	Rehabilitate two lanes	0.60	3,600	N	N	2	10	46.9
Route 33	Route 8 to Route 8	Rehabilitate two lanes/sidewalks	2.20	3,300	N	N	0	4	3.77
Route 10	Route 8 to Route 4	Rehabilitate four lanes	3.20	31,000	N	M	4	212	15.3
Route 6	Route 1 (Adelup) to Overlook	Rehabilitate two lanes/sidewalks	2.08	4,700	N	N	2	18	16
Route 6	Overlook to Route 1	Rehabilitate four lanes/shoulders	2.72	2,600	N	N	0	11	10.7
Route 6a	Route 6 to Route 6	Rehabilitate two lanes/sidewalks	0.80	NA	N	N	0	0	NA
Route 7	Route 24A to Route 6	Rehabilitate two lanes	1.60	12,100	N	M	0	24	8.49
Route 7a	Route 4 to Route 24a	Rehabilitate two lanes/sidewalks	2.20	600	N	N	0	11	57.1
Route 7b (Nelson)	Route 4 to Route 7	Rehabilitate two lanes/sidewalks	0.20	7,500	N	N	0	9	41.1
Route 24	Route 7a to Route 24	Rehabilitate two lanes	1.00	900	N	N	NA	NA	NA
Route 24a (Pale Kieran Hickey)	Route 7a to Route 24	Rehabilitate two lanes/shoulders	0.90	10,000	N	M	0	5	3.81
Route 17	Route 5 to Route 4	Rehabilitate two lanes/shoulders	7.40	4,300	N	N	1	49	11.1
Route 4	Route 1 to Route 10	Rehabilitate four lanes/sidewalks	3.99	25,000	N	M	3	341	23.9
Route 4	Route 2 to Route 4a	Rehabilitate two lanes/shoulders	9.31	2,300	N	N	1	69	22.8
Route 4a	Route 17 to Route 4	Rehabilitate two lanes/shoulders	2.40	3,700	N	N	1	11	10.3
Route 2	Route 4 to Erskin Drive	Rehabilitate two lanes/shoulders	8.74	3,800	N	N	0	34	7.01
Route 2a	Route 5 to Route 2	Rehabilitate four lanes/shoulders	1.80	16,200	N	N	2	33	8.88
Route 12	Naval Ordnance to Route 2	Rehabilitate two lanes/shoulders	2.70	3,000	N	N	0	16	13.5
Route 12a	Route 5 to Route 12	Rehabilitate two lanes/sidewalks	1.50	1,300	N	N	0	0	0
Route 19 (Dero)	Route 4 to Land Fill	Rehabilitate two lanes/shoulders	2.30	9,300	N	N	0	0	0
Route 40 (Aspinal)	Route 1 to Route 7a	Rehabilitate two lanes	0.20	3,900	N	N	0	0	0
Route 41 (5th Street)	Route 1 to Route 7a	Rehabilitate two lanes	0.20	100	N	N	0	0	0

NA = Not Applicable
*S = Severe, M = Moderate, N = None

A program of intersection improvements was developed to address existing peak hour congestion and safety problems. Intersections with the highest levels of congestion or the highest crash rates were targeted for improvements. Types of recommended improvements include additional turn lanes, restriping, installation of signage, installation of pedestrian crossings, and burial of overhead utility lines. The Intersection Improvements are shown in Figure S-11 and Table S-6.

Figure S-11: Intersection Improvements

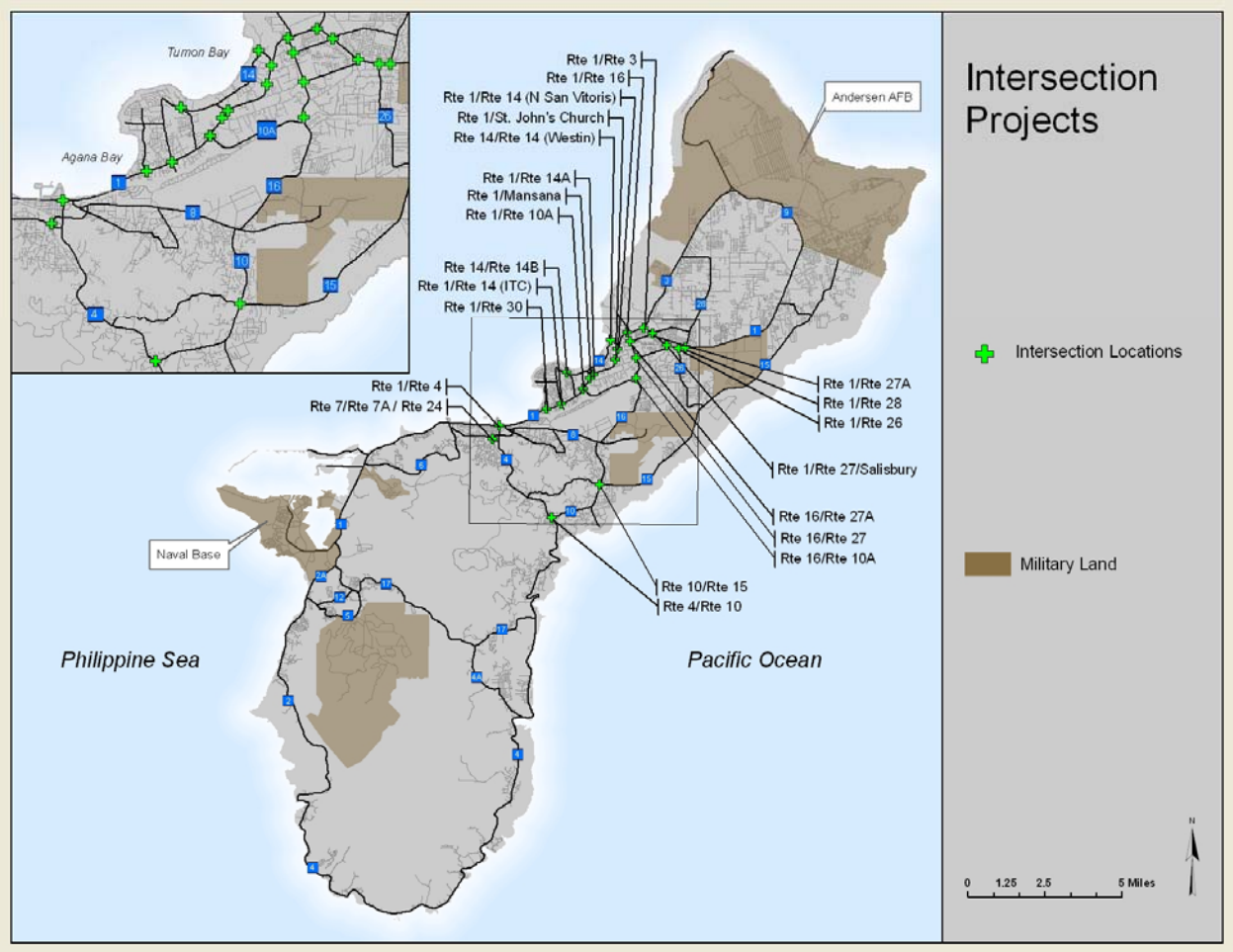


Table S-6: Intersection Improvements

Project Name/Intersection	Project Description	Peak Hour Congestion 2008	Identified Safety Problem*
Route 1/Route 28	Traffic signal modifications, signing, striping	No	X
Route 1/Route 26	Traffic signal modifications, sign/stripe and median	No	X
Route 1/Route 27/Salisbury	Additional southbound left turn lane	Yes	X
Route 1/Route 27a	Eastbound right-turn lane	Yes	X
Route 1/Route 3	Additional northbound left-turn lane	Yes	X
Route 1/Route 16	Traffic signal modifications, signing, striping	No	X
Route 1/Route 14 (N San Vitoris)	Additional northbound left-turn lane	Yes	
Route 1/Route 14a	NB/SB right-turn lanes	Yes	X
Route 1/St. John's Church	Minor street approach widening	Yes	
Route 1/Mansana	Signing, striping	No	X
Route 1/Route 10a	Northbound right-turn lane	Yes	X
Route 1/Route 14 (ITC)	Additional turn lanes and development access	Yes	X
Route 1/Route 30	Additional turn lanes	Yes	X
Route 1/Route 4	Southbound left turn lanes	No	X
Route 14/Route 14 (Westin)	Reconfigure northbound right-turn lane	Yes	
Route 14/Route 14b	Eastbound right-turn lane, extend northbound left-turn storage	Yes	
Route 14 Traffic Circle	Traffic circle signing, striping	No	
Route 4/Route 10	Additional southbound through lane	Yes	
Route 16/Route 27a	Traffic signal modifications, signing, striping	No	X
Route 16/Route 27	Additional turn lanes	Yes	X
Route 16/Route 10a	Restriping, signage for additional turn lanes	Yes	X
Route 7/Route 7a/Route 24	Reconfigure Y-intersection	Yes	X
Route 10/Route 15	Traffic signal modifications, signing, striping	No	X

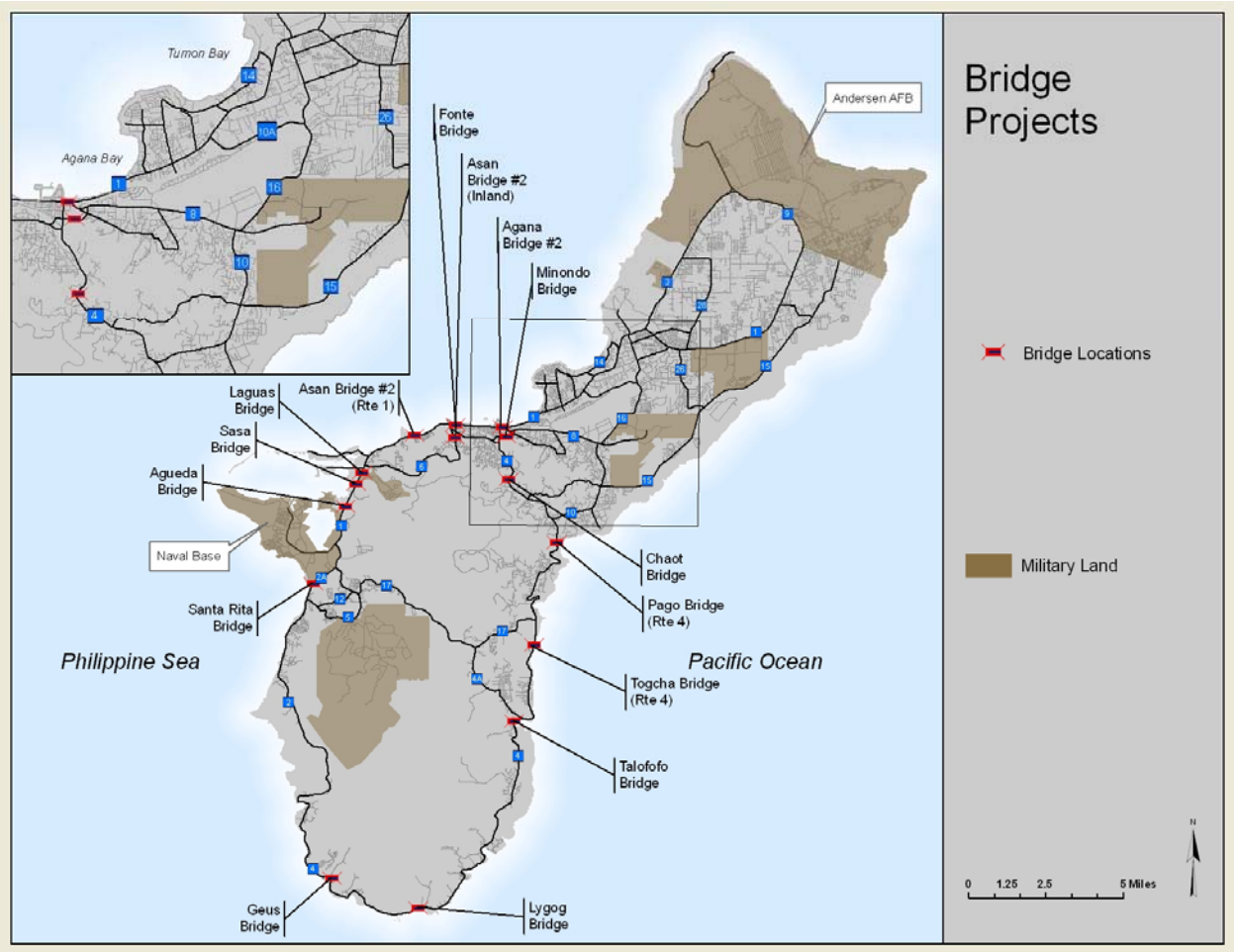
* Intersection with 30 or more crashes in 2005 and 2006.

The maintenance and preservation of Guam's bridges is critical to the safe and efficient movement of traffic on the island. Many of the bridges are in need of repair or replacement. Additionally, certain bridges will need to be widened to maintain consistency with the future capacity needs of the roadway on which they are located. Recommended bridge improvements are shown in Table S-7 and Figure S-12.

Table S-7: Bridge Improvements

Project Name	Project Description	Structural Rating
Route 1 Asan Bridge #1	Replace, widen to 6 lanes	1
Route 2a Namo Bridge	Replace, widen to 4 lanes	1

Figure S-12: Bridge Improvements



Village streets consist of collector streets and residential streets that connect residential areas to the main federal-aid roadway system. The village mayors were involved early in the GTP outreach program and were asked to develop a list of priority needs for their respective villages. A preliminary list of projects was identified and is the starting point for the village streets plan. The majority of needs related to the village streets include maintenance and preservation of the existing system. As identified by the mayors, the improvements serve the following purposes:

- Safety
- Pavement repair
- Drainage improvements
- Street lights and signage
- Road extensions, openings

S.3.2 Mass Transit Improvements

Transit capacity and operational improvements are needed to provide Guam residents a competitive choice in transportation. The transit plan consists of a core fixed-route system and demand-responsive service improvements. In the long-range component of the plan, it is anticipated that high-capacity transit improvements will be needed to support mobility for residents, visitors, and military personnel traveling Route 1. It is recommended that high-capacity transit concepts for Marine Corps Drive be implemented to enhance service and connectivity to the Tamuning/Tumon Bay area. The current TTIP has programmed $20 million in funds to acquire the 50 new vehicles needed to start the system in 2012, including the following:

- Purchase 20 paratransit vehicles
- Construct a bus maintenance facility
- Purchase 10 low-floor transit vehicles
- Initiate high-capacity transit service
- Purchase 25 low-floor transit vehicles as replacement buses in 2015–2025
- Purchase 25 low-floor transit vehicles as replacement buses in 2025–2030

An illustration of the recommended transit route improvements is shown in Figure S-13.

S.3.3 Pedestrian and Bicycle Improvements

The policy of the GDPW is to integrate bicycling options and sidewalks into the transportation system as a means to improve mobility and safety of non-motorized traffic. Bicycle and pedestrian facilities will be included in any roadway reconstruction or construction of new roadway facilities. The level of improvement will vary depending on the existing roadway conditions. Figure S-14 and Figure S-15 show the types of pedestrian/bicycle elements that will be considered on future roadway reconstruction and widening projects.

The improvements may include providing a 4-foot-wide shoulder or marked bike lane, widening the outside lane to 14 feet, completing a partially existing sidewalk, or constructing a new sidewalk or shared-use path. A shared-use path is a detached (or possibly attached) concrete trail that is a minimum of 8 feet wide to safely accommodate both pedestrian and bicycle travel. A shared-use path is recommended for areas of key pedestrian/bicycle connection across the island, while a bike lane is recommended for areas of high tourist activity to make a “Complete Street.” Sidewalks are generally most appropriate in urban areas while expanded road shoulders are more suitable to rural environments. Pedestrian and bicycle improvements are prioritized in areas near schools, parks, or community centers where feasible.

Figure S-13: Mass Transit Fixed-Route Improvements

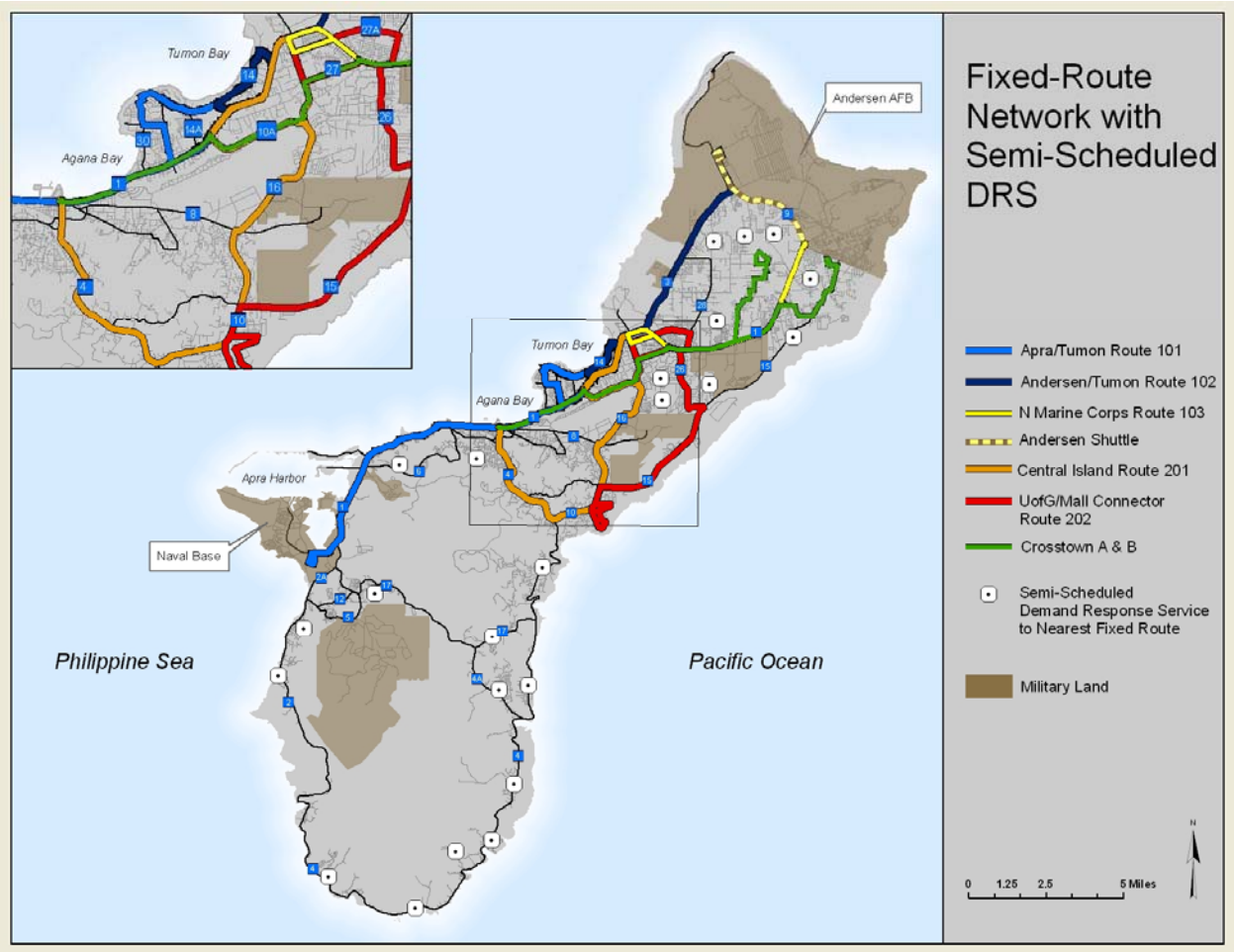


Figure S-14: Pedestrian Facility Improvements

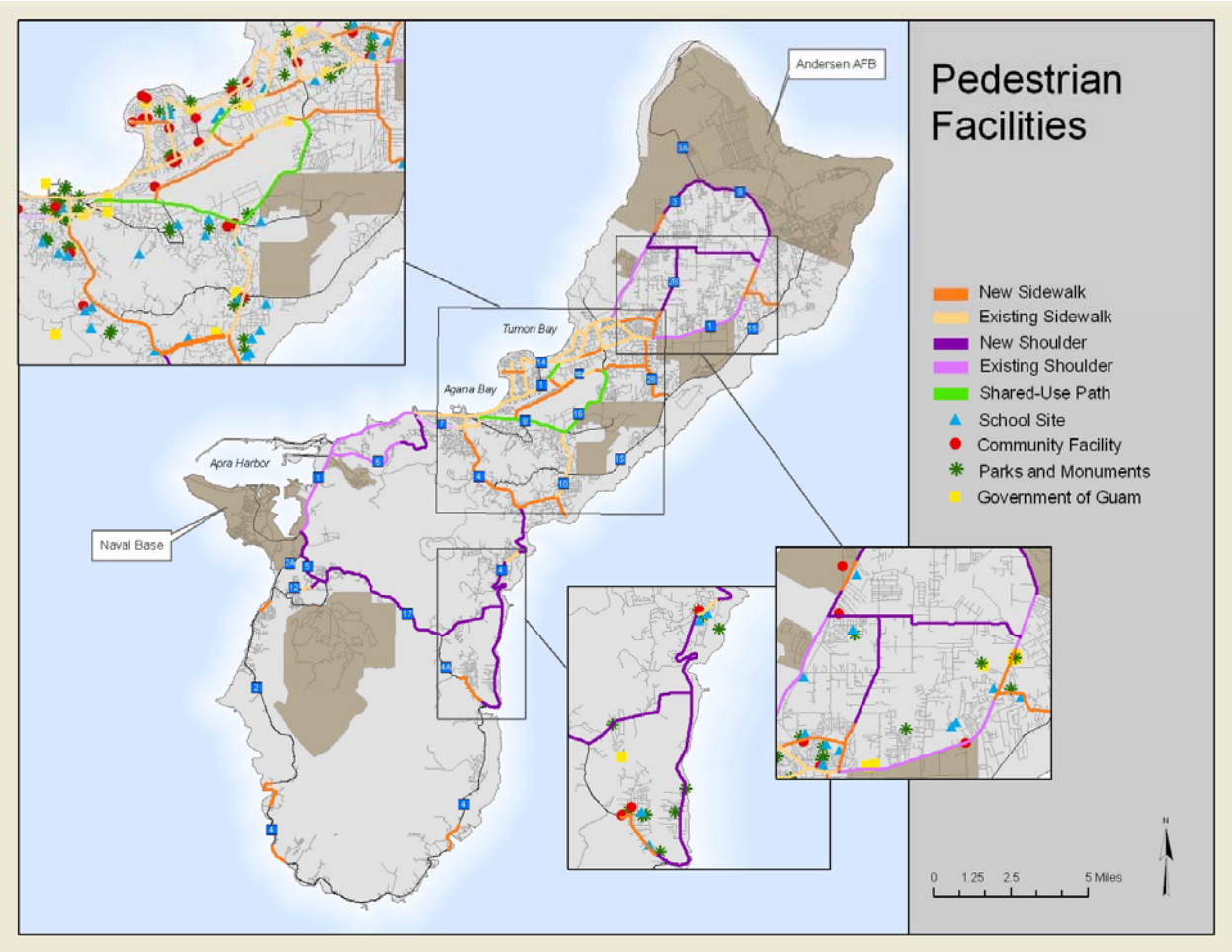
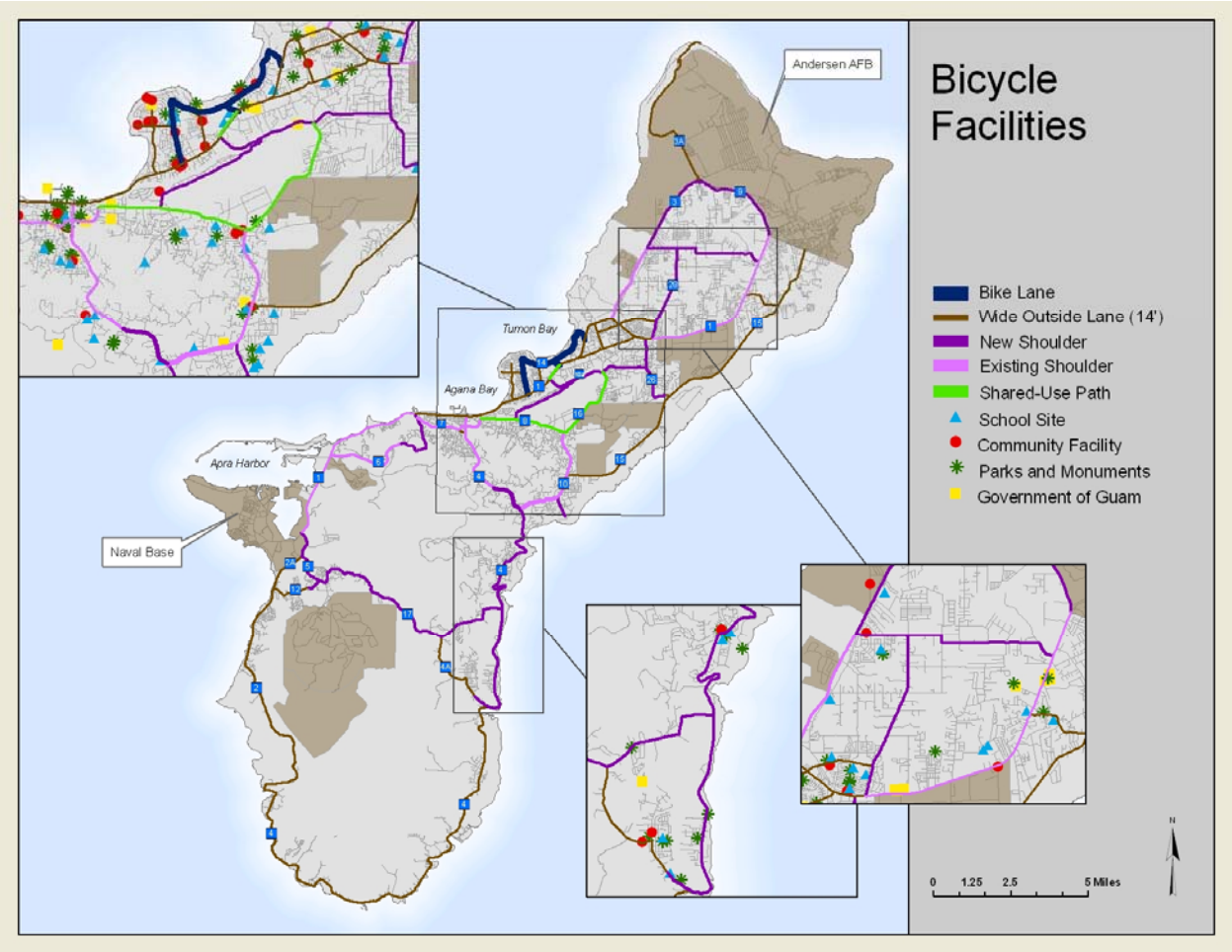


Figure S-15: Bicycle Facility Improvements



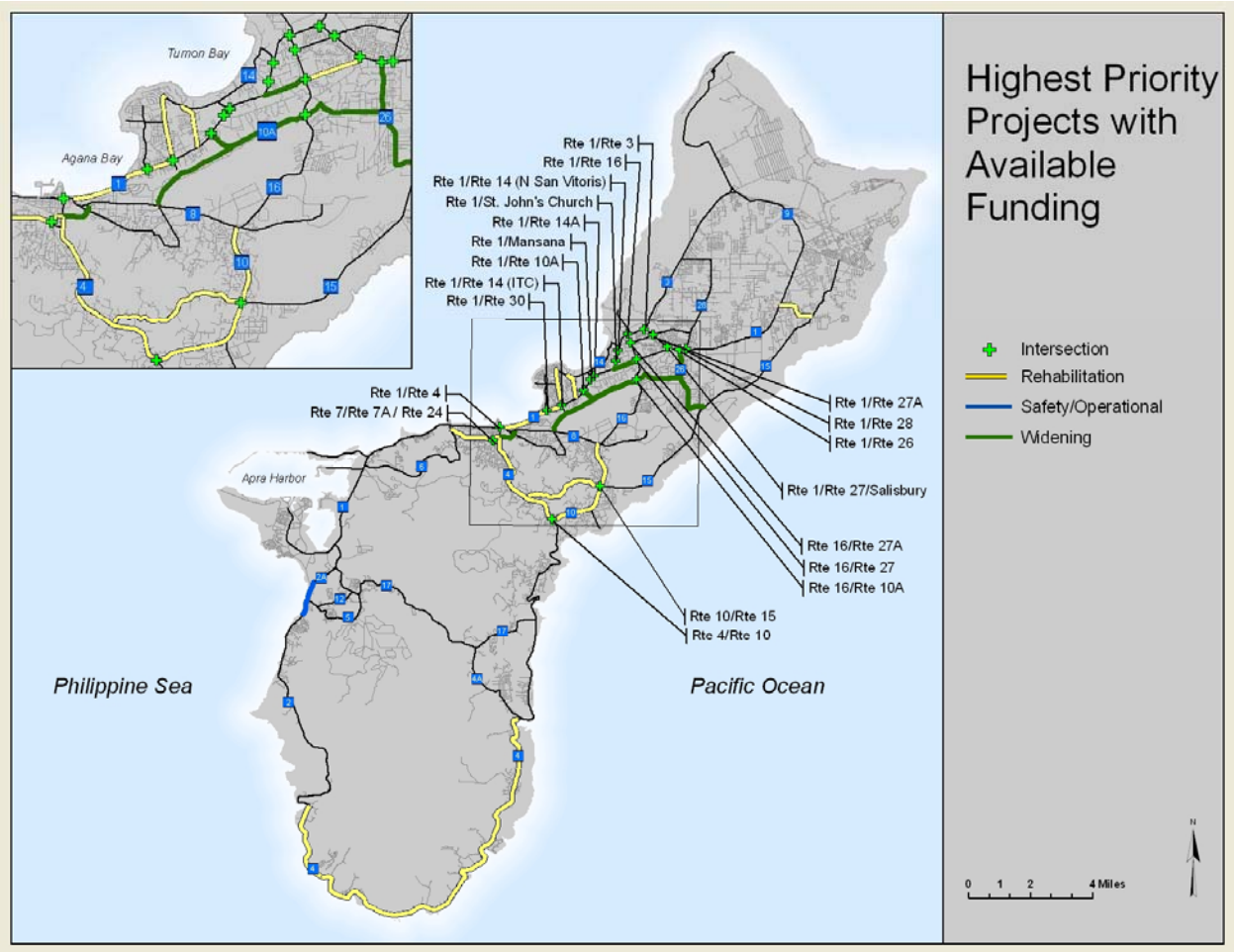
S.4 Transportation Funding

An analysis of potential future transportation funding was conducted to help identify a program of improvements that could be constructed through 2030 in a fiscally responsible way. Several sources are available for transportation funding: the Territorial Highway Program (THP), Emergency Relief Program, liquid fuels tax, various FTA programs, vehicle registration fees, federal earmarks, the Defense Access Road (DAR) program, Grant Anticipation Revenue Vehicle (GARVEE) bonds, the Transportation Infrastructure Finance and Innovation Act (TIFIA) credit assistance program, and other innovative public-private partnerships. It is anticipated that approximately $643.8 million will be available for implementation of transportation improvements through 2030. Table S-8 and Figure S-16 present the highest-priority projects with available funding.

Table S-8: High Priority Projects with Available Funding

Project Name	Project Limits	Project Description	Preliminary Project Cost
2012 to 2015 Improvements			
Route 10a (TTIP)	Route 1 to Airport	Widen from two to four lanes/sidewalks	$6.1
Route 7/Route 7a/Route 24		Reconfigure Y-intersection	$0.7
Route 1/Route 14 (ITC)		Additional turn lanes and development access	$1.2
Route 1/Route 30		Additional turn lanes	$1.2
Route 27 Ext (Hamburger Highway)	Route 16 to Route 1	Widen from two to four lanes/sidewalks	$16.2
Route 10a (TTIP)	Airport to Route 16	Widen from two/three to six lanes/sidewalks	$26.5
Miscellaneous safety/traffic operations			$6.0
2016 to 2019 Improvements			
Route 26 (TTIP)	Route 1 to Route 15	Widen from two to four lanes/sidewalks	$51.4
Route 2 (TTIP)	Route 2a to Erskin Drive	Safety/operational improvements	$11.2
Route 4 (TTIP)	McD to Route 10	Rehabilitate four lanes/shoulders	$28.7
Route 10/Route 15		Traffic signal modifications, signing, striping	$0.4
Route 1/Route 4		SB left turn lanes	$1.2
Miscellaneous safety/traffic operations			$6.0
2020 to 2023 Improvements			
Route 25 (TTIP)	Route 16 to Route 26	Widen from two to four lanes/sidewalks	$28.3
Route 16/Route 10a		Restriping, signage for additional turn lanes	$0.4
Route 1/Route 27a		Eastbound right-turn lane	$0.7
Route 1/Route 10a		Northbound right-turn lane	$1.2
Route 1/Route 27/Salisbury		Additional southbound left turn lane	$1.7
Route 1/Route 3		Additional northbound left-turn lane	$1.7
Route 1/Route 14a		Northbound/southbound right-turn lanes	$2.6
Route 16/Route 27		Additional turn lanes	$2.6
Miscellaneous safety/traffic operations			$6.0
2024 to 2027 Improvements			
Tijan Parkway	Route 10a to Route 8	Widen from two to four lanes/sidewalks	$53.6
Route 1/Route 16		Traffic signal modifications, signing, striping	$0.4
Route 1/Mansana		Signing, striping	$0.4
Route 4/Route 10		Additional southbound through lane	$0.7
Route 29	Route 1 to Route 15	Rehabilitate two lanes/shoulders	$5.0
Route 1	Route 14 (ITC) to Route 8	Rehabilitate six lanes	$25.4
Route 1/Route 28		Traffic signal modifications, signing, striping	$0.4
Route 16/Route 27a		Traffic signal modifications, signing, striping	$0.4
Route 1/Route 26		Traffic signal modifications, sign/stripe, and median	$0.7
Route 7a	Route 4 to Route 24a	Rehabilitate two lanes/sidewalks	$9.2
Route 14	Rnbt to Route 1 (ITC)	Rehabilitate four lanes	$9.7
Route 14b	Route 14 to Route 1	Rehabilitate two lanes/sidewalks	$3.3
Route 7a	Route 8 to Route 4	Widen from three to four lanes	$5.8
Miscellaneous safety/traffic operations			$6.0
2028 to 2031			
Route 7	Route 24a to Route 6	Rehabilitate two lanes	$6.7
Route 15 (Dairy)	Route 4 to Route 10	Rehabilitate two lanes/shoulders	$11.6
Route 1/St. John's Church		Minor street approach widening	$0.7
Route 1/Route 14 (N San Vitoris)		Additional northbound left-turn lane	$1.7
Route 10	Route 8 to Route 4	Rehabilitate four lanes	$26.4
Route 4	Route 2 to Route 4a	Rehabilitate two lanes/shoulders	$38.8
Miscellaneous safety/traffic operations			$6.0
Total			**$414.9**

Figure S-16: Highest Priority Projects with Available Funding



S.5 Policy Recommendations

The GTP also includes institutional and policy initiatives that will facilitate the planning process and implementation of projects on Guam. A summary of these recommendations is provided below.

- Asset mapping and utility coordination—GDPW should establish a coordinating committee, including GDPW, Guam Telephone Authority, Guam Water Works, and the Guam Power Authority, to coordinate utility issues. An integrated geographic information system (GIS) should be developed to coordinate utility and transportation projects.

- Recreate the Guam Mass Transit Authority—The Guam Mass Transit Authority would be recreated with the authority to own property, receive federal funds, enter contracts, and be governed by an independent board.

- Integrate transportation and land use planning—the partnership between the Territorial Land Use Commission and the GDPW should be strengthened to facilitate coordinated planning efforts and the development of public-private partnerships. Right-of-way acquisitions for transportation projects should be coordinated with the land use planning process.

- Establish level of service standards—GDPW should adopt a level of service E during peak periods for use in identifying and prioritizing transportation improvements.

- Streamlined GTP approval and update process—the GTP should be updated at least every five years and adopted by the Governor and Guam Legislature.

- Establish technical committee—establish a technical committee to coordinate with GDPW regarding selection of projects for the TTIP.

1.0 INTRODUCTION

1.1 Background and Purpose of the 2030 Guam Transportation Plan

The Government of Guam, through its Department of Public Works (GDPW) and Department of Administration, Division of Public Transportation Services, and the Federal Highway Administration (FHWA), as well as the Federal Transit Administration (FTA), have partnered to prepare this 2030 Guam Transportation Plan (GTP). The purpose of the GTP is to present a comprehensive strategy to improve transportation infrastructure throughout Guam. The GTP documents the impacts associated with the potential U.S. Department of Defense (USDOD) multiple services build-up expected to occur both in the short term (2010 to 2014) and the long term (to 2030).

The U.S. Department of Defense is aggressively planning a threefold expansion of its facilities and personnel for all armed forces service branches on Guam. Current information shows that the proposed increase includes 8,000 Marines, 1,250 Navy, 600 Army, and 2,630 Air Force personnel, bringing the total on-island military personnel to nearly 19,000. With the addition of support functions and military personnel dependents, the number of people who will relocate to Guam will be further increased.

The construction of residential and mission support facilities is expected to begin in 2010 and continue through 2014. By 2015, the full complement of military personnel and their dependents will be on Guam. Once the military members and their families are relocated to Guam, their numbers are forecasted to remain relatively constant through 2030.

A vision statement was adopted early in the GTP process to serve as the foundation of this plan. The GTP identifies specific goals and objectives to support the vision based on existing transportation, land use, and economic conditions.

In essence, this plan proposes to:

- Identify short- and long-range transportation needs and develop improvement strategies
- Address the impacts of the on-going military build-up
- Establish sustainable financing and project implementation recommendations
- Identify policy and institutional improvements to promote better decision making

The GTP is a financially constrained vision that is linked to available and foreseeable funding sources. It not only documents the total transportation needs for Guam in both the short- and long-term, but focuses on improving the efficiency, safety, and effectiveness of existing roadways and maintaining them in future years. The plan provides a framework for enhancing Guam's mass transit system and improving the bicycle and pedestrian system. The GTP also includes management strategies designed to improve traffic flow, operations, and the coordination of construction activities with utility providers. It presents recommendations from village mayors for village streets and sets the stage to conduct detailed assessments of each community's specific needs.

The 2030 GTP is a dynamic document that prioritizes projects and makes recommendations based on the most current information available. The plan will be updated at a minimum of every five years. At each update, current conditions and future trends will be assessed and the appropriate modifications made to the plan.

Future financial conditions are one example of a trend that will need to be re-assessed periodically. The credit crisis during the fall of 2008 places severe financial limitations on both government entities (including the federal government) and private firms in acquiring funds to maintain business operations. Conversely, it is possible that Guam's projected population and economic growth may result in additional revenues. Changes in policies both at the local and federal levels may also affect priorities. For example, the potential for federal set-asides (earmarks) for specific transportation projects and/or adjustments to Guam's existing tax structure may further impact financial resources and bonding capacity.

1.2 Relationship to 2020 Draft Guam Highway Master Plan

In 2005, the Draft Guam Highway Master Plan (GHMP) was submitted to the GDPW. The Draft GHMP was the precursor to the GTP and provided an assessment of demographic, land use, economic, and traffic conditions, as well as a travel demand model to forecast future traffic. It also re-adopted the goals and objectives of the 2010 GHMP and integrated those goals and objectives into the updated 2020 planning effort. The 2020 GHMP included short- and long-range recommendations for transportation improvements though the year 2020.

The GTP looks at current trends pertaining to population, employment, and travel conditions with the most current data. A detailed inventory of the economic, land use, and travel demand characteristics of Guam was also completed. This information is the basis for a more detailed evaluation of the impacts resulting from the military build-up. The GTP specifically documents the impacts to transportation from the following:

- **2010–2014 military build-up period**—during this period, Guam will experience a massive infusion of temporary off-island construction workers to support the construction of military facilities.
- **Dramatic increase in new jobs**—the military build-up will fuel, through multiplier effects, a dramatic increase in employment.
- **2015 post-build-up period**—the GTP also compares the effects of the build-up to the post-build-up period, including projections to 2030. The impact analysis resulting from these developments helps define a wide variety of project needs for Guam consistent with the mission statement, goals, and objectives.

New goals and objectives were developed to reflect an emphasis on safety, greater integration between transportation and land use, to address military, tourist, and resident needs, and to provide for a wider variety of transportation options that are more consistent with the planning factors identified in the Safe Accountable Flexible Efficient Transportation Equity Act—A Legacy for Users (SAFETEA-LU). Performance measures and a project prioritization process were also developed to help the GDPW select projects that reflect the priorities established during the planning process.

Another enhancement of the GTP is the commitment to multimodal improvements. The GTP takes a holistic and integrated view of transportation needs and establishes the foundation for new improvements that go beyond road building. Recommendations are presented in the plan to help establish a new fixed-route transit system, bicycle and pedestrian improvements, and policies to streamline construction synchronization.

1.3 Relationship to Territorial Transportation Improvement Plan

As a long-range strategic plan designed to conform to the requirements of SAFETEA-LU, the GTP examines a 20-year span and establishes the priorities and framework for future transportation improvements. The GTP is a planning document that identifies those projects that are likely to be funded by a combination of local and federal resources within the 2030 timeframe. It also provides an illustrative list of projects that, while unfunded, are directly related to documented needs arising from anticipated growth.

In contrast, the Territorial Transportation Improvement Plan (TTIP) is a short-term budgeting document that identifies transportation projects that will be implemented during the current four-year period. The link between the two documents is that the projects identified in the long-range GTP provide the basis for selection and prioritization of projects in the TTIP. The GTP identifies a list of needed improvements and the TTIP establishes funding for those deemed to be the highest priority within the immediate future. Projects are required to be included in the GTP before they can be programmed (funded) in the TTIP.

The TTIP programs projects in terms of their stage, such as preliminary design, final design, right-of-way acquisition/environmental clearance, or construction. It includes a more detailed description of the project's design concept and scope (number of lanes and location), a cost estimate, and an anticipated funding source. The TTIP alerts FHWA and FTA of the need to process funding requests for project implementation to meet established schedules.

1.4 Plan Development Process

The GTP was developed through a coordinated and continuing process. Elements of the planning process included the following:

- A community outreach program to engage Guam's citizens and stakeholders in the process to identify project goals and objectives, determine transportation needs, and obtain feedback regarding recommendations for projects to be included in the GTP
- An inventory of existing transportation system conditions to establish a baseline for determining future needs
- A review of historical transportation and demographic data and trends
- An analysis of previous planning efforts, including the 2020 Draft GHMP
- The development, concurrence, and application of performance measures in order to identify, evaluate, and prioritize transportation improvements
- A proactive planning exercise with the military to fully determine their needs, requirements, and potential funding sources

- Development/refinement of Guam's travel demand forecasting model
- Identification of transportation improvements to address anticipated congestion problems
- Review of potential federal and local funding sources
- Prioritization of projects based on available funding, goals and objectives, and public comments
- Development of the 2030 Guam Transportation Plan document

Public and stakeholder outreach was conducted to assist in the identification of Guam's transportation needs, alternatives, and priorities. Key stakeholders, including local and federal agencies and the public, were involved throughout the development of the document and will remain involved throughout its implementation.

The public outreach and involvement process was initiated with a series of community and stakeholder meetings which were held in Dededo, Agana Heights, and Agat in February 2008. The purpose of these meetings was to gather community input pertaining to the draft goals, objectives, existing conditions, and performance measures of the GTP. The public was encouraged to identify existing problems that need to be addressed, as well as potential improvements required for the future transportation system. Meetings were also held with Village Mayors and various civic and business groups to provide information and obtain feedback for the GTP planning process.

A second series of public meetings was held in October 2008. The second series of meetings presented to the public the draft recommendations of the GTP. Specifically, the public was given the opportunity to review the roadway plan, the transit plan, the bicycle and pedestrian plan, and the methodology by which projects were ranked. The public was asked for their input to assure that the recommendations were relevant to their concerns and preferences.

The recommendations contained in the GTP are designed to:

- Improve Guam's current roadway system to acceptable operating standards
- Provide a safe and efficient transportation system
- Provide a variety of alternative travel modes
- Develop an integrated transportation and land use system
- Maximize the availability of limited funding
- Address the transportation needs of the current residents of Guam
- Address the transportation needs generated by the proposed military build-up

The GTP is a living document that has been developed as a foundation for making sound transportation policy decisions to improve the overall quality of life for the people of Guam, now and in the future.

1.5 Statutory Requirements

The GTP is subject to and must address several laws and regulations applicable to transportation planning and funding. SAFETEA-LU was signed into law in August 2005 and is the current national transportation legislation providing the guiding principles behind transportation decision-making throughout the United States.

SAFETEA-LU established eight Planning Factors to guide transportation decisions and includes the following mandates:

1. Support economic vitality, especially by enabling global competitiveness, productivity, and efficiency.

2. Increase the safety of the transportation system for all motorized and non-motorized users.

3. Increase the ability of the transportation system to support homeland security and to safeguard the personal security of all motorized and non-motorized users.

4. Increase accessibility and mobility of people and freight.

5. Protect and enhance the environment, promote energy conservation, improve the quality of life, and promote consistency between transportation improvements and state and local planned growth and economic development patterns.

6. Enhance the integration and connectivity of the transportation system, across and between modes, for people and freight.

7. Promote efficient system management and operation.

8. Emphasize the preservation of the existing transportation system.

Additionally, the GTP must have a minimum 20-year horizon at time of adoption and must be updated no less than every 5 years.

2.0 WHAT IS THE VISION?

The purpose of developing a transportation plan is to encourage good decision making. This is particularly important in light of the transformation Guam will experience over the next decade with the proposed military build-up and its associated economic impacts.

As an island, Guam's land mass, infrastructure, and resource capabilities are limited. While its basic transportation infrastructure is in place, Guam faces a number of challenges pertaining to the system's ability to accommodate growth. A sound transportation plan for Guam must include strategies that focus on increasing system efficiency to support Guam's anticipated population increase, encourage economic activity, and provide an improved quality of life for its residents. The plan must also recognize that unique transportation needs exist on Guam. Many roads evolved over a time before the automobile was dominant. As such, many roads are circuitous, narrow, and function in a manner inconsistent with modern mobility needs.

A vision supported by well conceived and practical goals and objectives was needed to begin the process to address these challenges. The goals and objectives were initially drafted after extensive meetings between the planning team, GDPW management, and FHWA. The GDPW vision statement is the foundation of the GTP and is as follows:

"To provide a safe, efficient, and sustainable transportation system for our residents, visitors, and military personnel that supports economic diversification, resource conservation, and an exceptional quality of life."

Goals for the Guam Transportation System

Defining the needs and assuring that citizens have a voice in the planning process is essential to ascertain that this fundamental vision is realized. To this end, public outreach efforts were undertaken to help establish sound goals and objectives to support the vision. These efforts included interaction with stakeholders and citizens through public meetings, presentations, and other outreach efforts as described below.

Creating public awareness of the plan through the media—this was accomplished through press releases, press conferences, print, radio and television interviews, local talk shows and a limited amount of paid advertising.

Speaker circuits—these outreach efforts included speaking engagements at civic and business organization meetings, such as the Guam Chamber of Commerce, the Guam Contractors Association, and the Guam Hotel & Restaurant Association. The larger organization presentations were generally covered by the media and publicized through membership communications. Moreover, the larger civic organization meetings generally included businesses with an interest in Guam's transportation systems, such as commercial haulers, contractors, transit companies, commercial property owners, and retail/wholesale businesses. Consequently, many of the concerns of these specific users were able to be addressed without additional meetings.

User group meetings—these included making presentations and leading discussions at meetings with specific user groups affected by the program, such as tour bus companies, public transit operators, trucking companies, and construction companies among others. Such meetings were conducted on an as-needed basis and were primarily used to gather

any additional or specific information necessary for the planning effort. In addition, presentations were made at public forums, such as the Guam Industry Forum, with specific focus on the pending Marine relocation to Guam and its impacts on the existing transportation infrastructure systems.

Community group communications—social, ethnic, cultural, and other community clubs or associations are valuable assets in building community consensus. Equally important are senior citizens' associations and organized recreational or sports associations, such as cyclists or motorcycle clubs. Outreach to these groups was accomplished through public village meetings in the north, central, and southern regions.

Public official communications—elected or appointed representatives were communicated with directly through letters, phone conferences, round table discussions, and briefings.

Meetings with local and federal agencies—information exchange with agency planners and statisticians was crucial to the development of the GTP. Organized meetings with specific goals were conducted for both local and federal officials to ensure that accurate statistics were gathered and all policy and process requirements were met as part of the planning effort.

Combined with a review of existing conditions, advanced traffic forecasting techniques, and sound engineering practices, eleven primary goals and supporting objectives were established to address Guam's long-range transportation system needs. These goals and objectives were presented to the citizens of Guam in a series of three meetings in February 2008. The public response was positive and supportive of the developed goals as presented at these meetings. The goals and objectives are provided below.

Goal 1—Safety

To plan, construct, operate, and maintain a multimodal transportation system that is safe for system users and to promote a system that facilitates effective emergency response, evacuation, and recovery.

Objectives

1.1 Reduce the overall crash rate on Guam roadways.

1.2 Reduce the overall fatality rate in all transportation modes, including automobiles, bicycles, and pedestrians.

1.3 Minimize emergency response time.

1.4 Provide efficient emergency evacuation routes.

1.5 Improve accessibility to typhoon evacuation shelters.

1.6 Provide transportation options during emergency evacuation for all system users.

1.7 Improve safety through enforcement and education programs.

Goal 2—Integrate Transportation and Land Use

To coordinate the transportation system with planned land uses to encourage an efficient transportation system and the development of communities promoting transportation choices.

Objectives

2.1 Provide transportation facilities and services that reinforce the land use and development plans of the Government of Guam.

2.2 Coordinate transportation planning among the Department of Public Works, the Guam Power Authority, the Guam Waterworks Authority, the Port Authority, the Aviation Authority, and the U.S. Department of Defense.

2.3 Apply transportation and land use planning techniques that support multimodal transportation and smart growth development patterns.

Goal 3—Accessibility, Mobility, and Intermodal Connectivity

To improve on-island and inter-island accessibility and mobility for people and goods across all modes of transportation.

Objectives

3.1 Plan and develop each mode of transportation in coordination with other modes to promote convenience, efficiency, and cost effectiveness.

3.2 Enhance the connectivity of key destinations on Guam.

3.3 Increase mode choice and access for persons with disabilities, low-income residents, non-English-speaking citizens, and elderly populations, as well as military personnel and their dependents and off-Guam workers who may not own autos.

3.4 Provide an integrated network of pedestrian and bicycle facilities.

3.5 Promote the benefits of transit, walking, and bicycling as practical modes of transportation.

3.6 Explore enhanced connections for freight and passenger movements with Rota and Saipan.

Goal 4—System and Services Efficiency

To maximize the efficiency of existing transportation facilities and services through improved management, operations, and maintenance activities.

Objectives

4.1 Consider congestion management strategies such as Transportation System Management (TSM) and Transportation Demand Management (TDM) as part of the planning and programming process of transportation improvements.

4.2 Reduce traffic congestion and delays.

4.3 Reduce transit travel times.

4.4 Provide transit service to additional geographic areas.

4.5 Improve transit access, choices, and service for the transportation disadvantaged.

Goal 5—Environmental and Resource Conservation

To plan, construct, operate, and maintain the transportation system to support the sustainability and preservation of natural, historic, and cultural resources.

Objectives

5.1 Avoid or minimize and mitigate potential adverse effects of transportation on the natural, historic, and cultural resources of Guam.

5.2 Involve federal, Guam government, local, and native stakeholder groups in the transportation planning and programming process on an on-going basis.

5.3 Reduce energy requirements of the transportation system.

5.4 Promote healthy lifestyles by providing pedestrian and bicycling facilities.

5.5 Develop a transportation system that improves air quality.

Goal 6—Economic Diversification and Vitality

To support the expansion and diversification of Guam's economy through the efficient and effective movement of people and goods, services, and information.

Objectives

6.1 Provide for safe and efficient intermodal freight transport.

6.2 Identify transportation programs and projects that support tourism.

6.3 Provide efficient access to existing and planned activity centers.

Goal 7—Communication and Collaboration

To improve coordination, communication, and cooperation among transportation users, providers, and those affected by transportation activities.

Objectives

7.1 Implement an effective and ongoing community outreach program.

7.2 Include typically under-represented groups, populations, and areas into the transportation decision-making process.

7.3 Support informed decision making through improved communications and responsive planning and programming methods and techniques.

7.4 Support collaborative working relationships among federal, territorial, and village interests with the objective of removing barriers so the transportation system can function seamlessly.

7.5 Consult with other federal agencies and Guam departments to achieve transportation goals.

Goal 8—Program and Project Funding

To create a transportation funding structure that is stable and reliable and supports a viable transportation system to achieve territorial and local goals now and into the future.

Objectives

8.1 Develop a financially responsible implementation plan that allocates and maximizes the use of all available financial resources.

8.2 Include existing and anticipated funds and life cycle costs in the planning decision-making process.

8.3 Reduce transportation costs by promoting energy-efficient modes and developing intermodal transportation facilities that promote the efficient and seamless transfer of people and goods—especially between ports and the associated civilian and military facilities throughout the island.

8.4 Seek out and promote public-private partnerships for innovative delivery of services. These partnerships may include design-build methods, competitive contracting mechanisms for transit services, and pursuit of joint development opportunities with the tourist sector.

Goal 9—Title VI Civil Rights/Environmental Justice

To comply with Title VI of the Civil Rights Act of 1964 and environmental justice requirements of Executive Order 12898 so that services, burdens, and benefits of the transportation system are fairly distributed to all people, regardless of race, national origin, or income; that residents enjoy the same degree of protection from disproportionate adverse impacts; and that residents have access to meaningful participation in decision-making.

Objectives

9.1 Develop a process to identify and evaluate potential environmental justice impacts of transportation projects during the planning and programming processes.

9.2 Provide equal access to public information and decision-making about transportation planning, financing, construction, operations, and maintenance activities.

Goal 10—System Preservation

To preserve existing transportation facilities and services through an ongoing maintenance program.

Objectives

10.1 Develop standards for maintaining transportation facilities, services, and equipment for all modes of transportation.

10.2 Bring the existing transportation infrastructure into a state of good repair.

10.3 Plan and program improvements to keep the transportation infrastructure in a state of good repair.

Goal 11—System Security

To improve the security of general travel, public transit, and goods movement.

Objectives

11.1 Identify the standards and policies necessary to enhance the security of transportation facilities and services and incorporate them into the planning, design, construction, and operation of transportation facilities and services.

11.2 Facilitate the development of transportation projects that enhance island-wide security.

11.3 Work with freight operators to enhance the security of freight transportation systems that move goods to and from Guam.

Addressing both public and private transportation needs and challenges for the next 20 years, these goals serve as a foundation for making sound decisions. These decisions will foster prosperity, enhance mobility, and afford Guam's citizenry a safe, efficient, and sustainable transportation system that will enhance the overall quality of their lives. Methods for ensuring that these goals and objectives are translated into criteria for project selection will be discussed in subsequent sections of the plan.

3.0 EXISTING DEMOGRAPHIC AND TRANSPORTATION CONDITIONS

3.1 Why Are Existing Demographic Conditions Important to the GTP?

Transportation needs are directly related to where people live, work, shop, play, and go to school. The biggest land-use factor that drives travel patterns is the location of housing and jobs. Travel between home and work accounts for the majority of morning and afternoon traffic—the most congested times on the roadways.

Before new transportation projects are proposed, it is important to understand how the current and future land use characteristics will impact the transportation system. In order to understand the integration of land use and transportation, some of the questions to address early in the planning process include:

- Where do people live and work now?
- Where will people live and work in the future?
- How do people travel between home and work?
- Where are major destinations located?
- Does the transportation system provide adequate ways for people to travel to their destinations?
- Are there a variety of ways to travel—roadways? transit? sidewalks? bicycle paths?

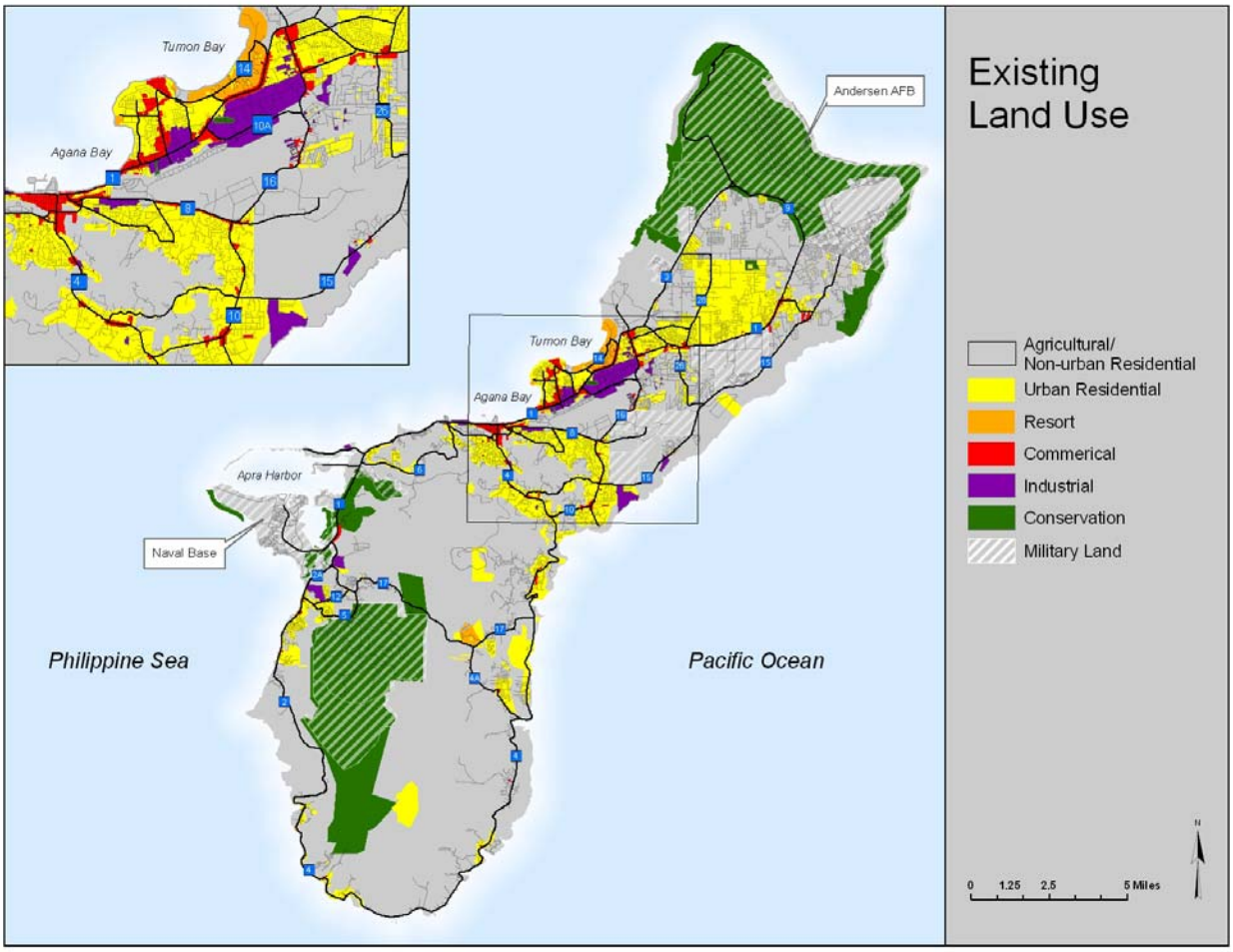
This chapter analyzes available land use and demographic data to provide an understanding of existing conditions and to serve as the basis for projecting future conditions (as discussed in Chapter 4, Future Demographic and Traffic Conditions).

3.1.1 Existing Land Use

Land use analysis helps set the stage for the study of the transportation system. Good land-use planning is the critical component that allows people to efficiently and effectively connect where they live, work, shop, or go to school. The Government of Guam is currently developing a Land Use Master Plan which will assess the current land-use patterns and determine how to best utilize the land in the future to meet the needs of the island. This effort builds on a land-use plan that was developed roughly nine years ago. The close coordination of the Land Use Master Plan with transportation planning will be a critical part of providing an integrated and efficient environment on Guam.

Guam is divided into 19 municipalities, commonly called villages. The capital of Guam is Hagatna, which is located on the central west coast. As shown in Figure 3-1, the most heavily urbanized areas, those with the most housing and jobs, are found near Hagatna, Agana Bay, and Tumon Bay. Other urbanized areas are located adjacent to major roadways that traverse the island. The primary land uses on the island are military/federal and non-urban

Figure 3-1: Land-Use Map



Source: PB, 2008.

residential/agricultural lands, which collectively cover approximately 60 percent of the island. Other major land uses are conservation space (14 percent), parks (10 percent), and residential areas (8 percent).

Guam contains many unique physical land resources that are protected by both local and federal polices. These policies, which include seashore protection and coastal zone management as well as conservation districts and wetland preserves, play a major role in determining both real and potential future land uses. The Guam National Wildlife Refuge is located on the northern portion of the island and contains habitat for the endangered animals.

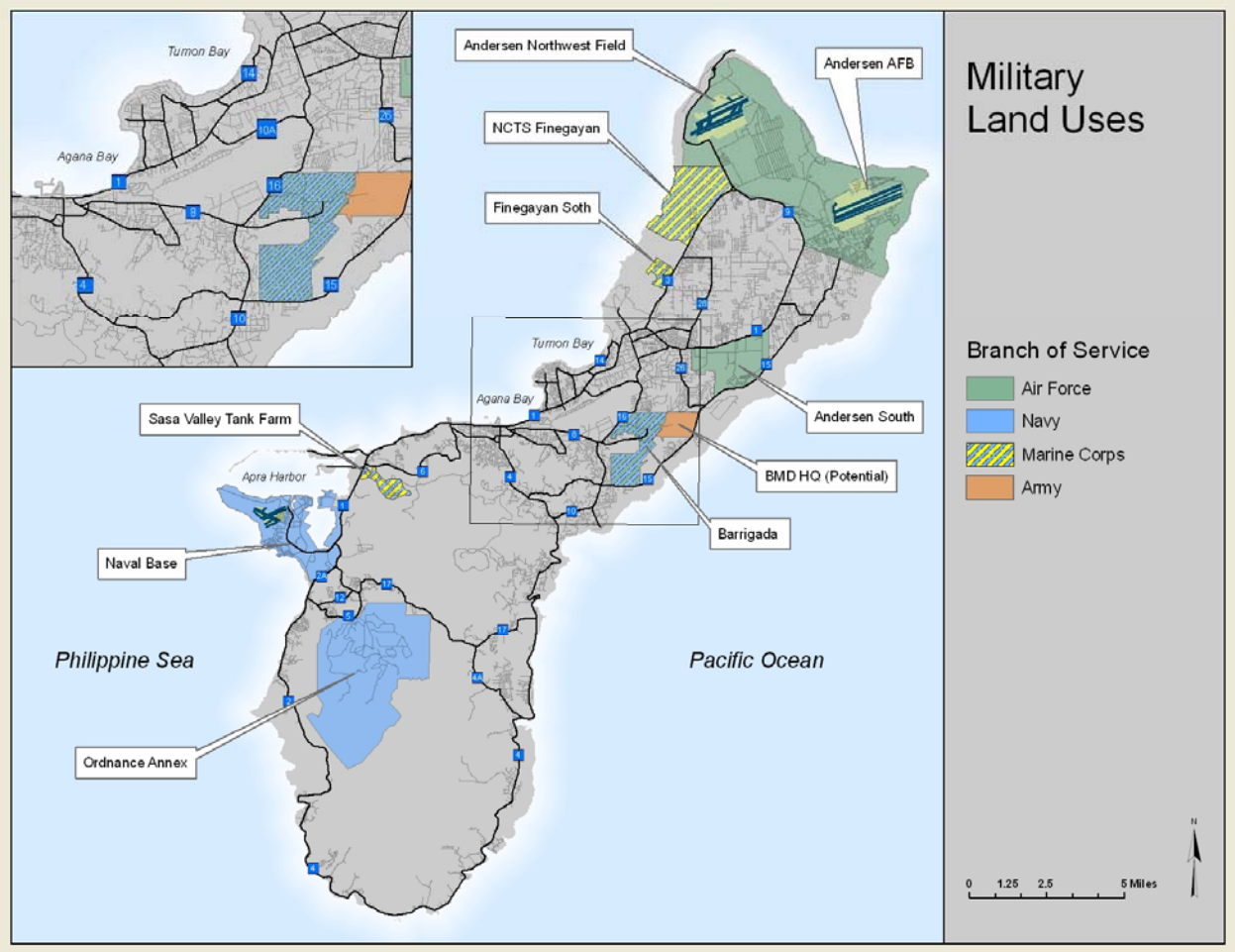
Residential land use is concentrated in the northern and central parts of the island along the major roadways. High-density development, such as apartments and condominiums, can be found in Tamuning, Agana Heights, and Mongmong-Toto-Maite. Most other residential development consists of single/multi-family homes, with the majority occurring in Yigo and Dededo because of the relatively flat, accessible land.

Commercial and industrial uses cover less than 3 percent of Guam. Hagåtña is the center of most commercial activities with legal offices, banks, department/variety stores, insurance, technical and professional services, and recreation facilities. The majority of the resort hotels are located in Tamuning along Tumon Bay just north of Hagatna. Tourism travel demand, which is centered in the Tumon Bay area, relies on Routes 1, 14, 14a, and 14b. Much of the travel demand on Guam results from the need to move people from the rural and urban residential districts to the commercial/industrial centers along Marine Corps Drive.

Freight and goods are transported from the commercial Port of Guam to southern Hagatna, as well as the Harmon Industrial Park and the commercial corridor along Route 1, both in Tamuning. Freight and goods are also transported from the International Airport to the areas with heavy commercial and military land uses.

The USDOD maintains jurisdiction over several bases in Guam that cover approximately 39,000 acres as shown in Figure 3-2. The presence and location of the military bases on Guam are important because they are a major influence on the travel patterns. Military travel is focused on Andersen Air Force Base and Naval Base Guam/Apra Harbor.

Figure 3-2: U.S. Military Bases on Guam



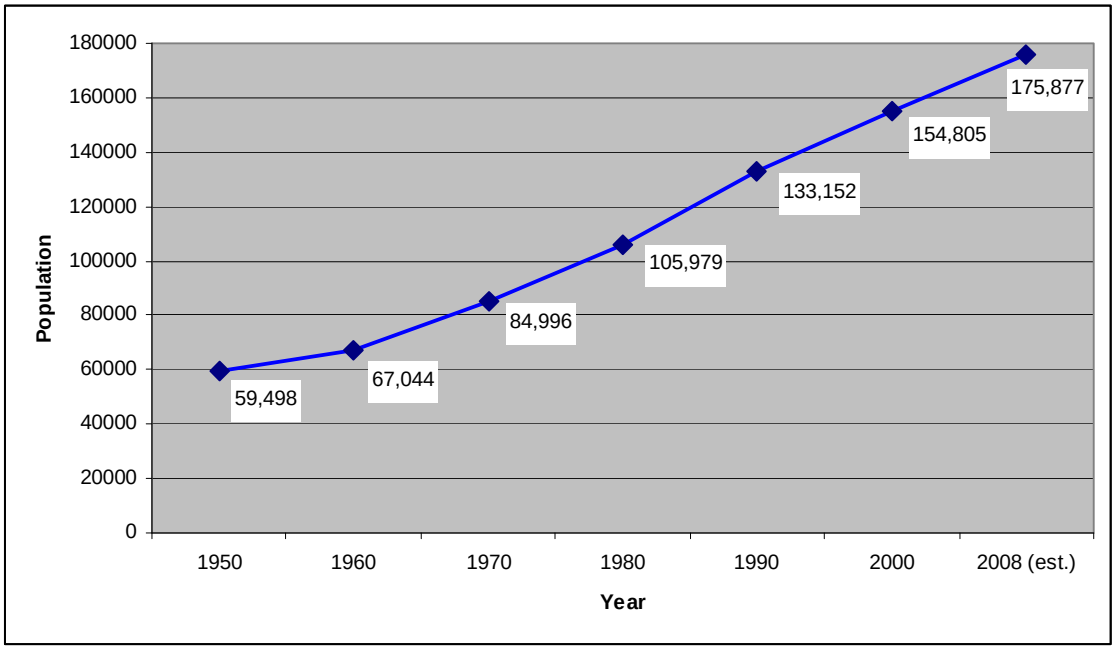
3.1.2 Population and Employment

This section enhances the general land-use discussion by quantifying the number of people and jobs on the island and specifying their locations by village. This additional detail helps to provide a better understanding of the needs for the transportation system based on where people are traveling. The demographics of Guam are about to change dramatically due to the proposed military build-up anticipated for 2010–2014. The sheer number of future residents and workers, as well as potential changes to the location of housing and jobs, will greatly impact the transportation needs on Guam. Future conditions include the short-term impacts, as well as the longer-term impacts, of the military build-up.

3.1.2.1 Current Population

The population of Guam is comprised of permanent residents as well as military personnel and their dependents. Since becoming a U.S. territory in 1950, Guam has experienced a moderate, steady increase in population. The U.S. Census Bureau estimates that more than 175,000 persons currently live on Guam (mid-year 2008). Although the rate of growth has slowed since 1950, the total number of residents has continued to increase. Figure 3-3 shows the historic growth trends.

Figure 3-3: Guam Total Population for Census Years 1950-2008



Source: U.S. Census Bureau

3.1.2.2 Population

The majority of the island's population is concentrated in the central and northern areas of Guam. The villages of Dededo, Yigo, Tamuning, and Mangilao have the greatest population concentrations, making up more than 60 percent of Guam's total

population. Military personnel and their dependents account for 8 percent of the population and are located primarily in the Santa Rita and Yigo villages.

Table 3-1 shows the villages of Guam listed in order from the highest to the lowest population and Figure 3-4 shows 2008 population by village.

Table 3-1: Guam Population by Village (2008)

Village	Population	% of Total Population
Dededo	49,137	28%
Yigo	22,128	13%
Tamuning	20,471	12%
Mangilao	15,319	9%
Barrigada	9,332	5%
Santa Rita	8,522	5%
Yona	7,563	4%
Mongmong-Toto-Maite	6,642	4%
Chalan Pago-Ordot	6,535	4%
Agat	6,426	4%
Agana Heights	4,477	3%
Talofofo	3,653	2%
Inarajan	3,469	2%
Sinajana	3,242	2%
Merizo	2,457	1%
Asan	2,351	1%
Piti	1,893	1%
Hagatna	1,164	1%
Umatac	1,009	1%
Total All Villages	**175,790**	**100%**

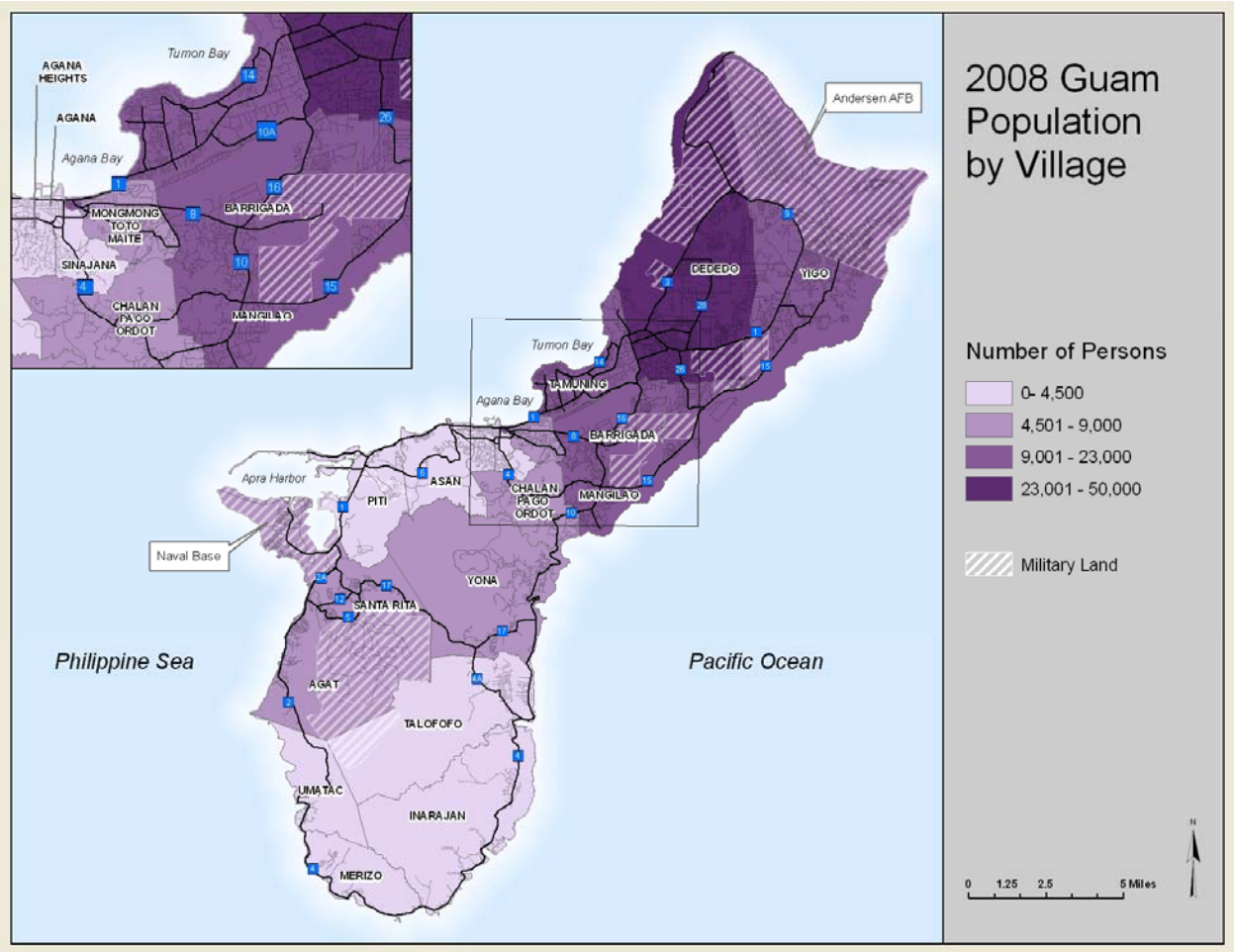
Source: U.S. Census Bureau

3.1.2.3 Employment

Since 1984, overall employment growth on Guam has fluctuated a great deal due to international events, U.S. events, and natural disasters. From 1984 to 1990 employment growth was very strong, primarily due to the economic boom in Asia that spurred an increase in tourism and related growth. However, the Asian stock market crash in the early 1990's and several Base Realignment and Closure decisions by the USDOD caused overall employment growth to stagnate for most of the decade.

Since 2000, growth on Guam has been negatively impacted by two major typhoons, the SARS health epidemic, the terrorist attacks of September 11, 2001, and the Iraq War. These events precipitated a decline in employment due to decreased tourism and an overall decline in economic activity on the island.

Figure 3-4: Guam Population by Village (2008)

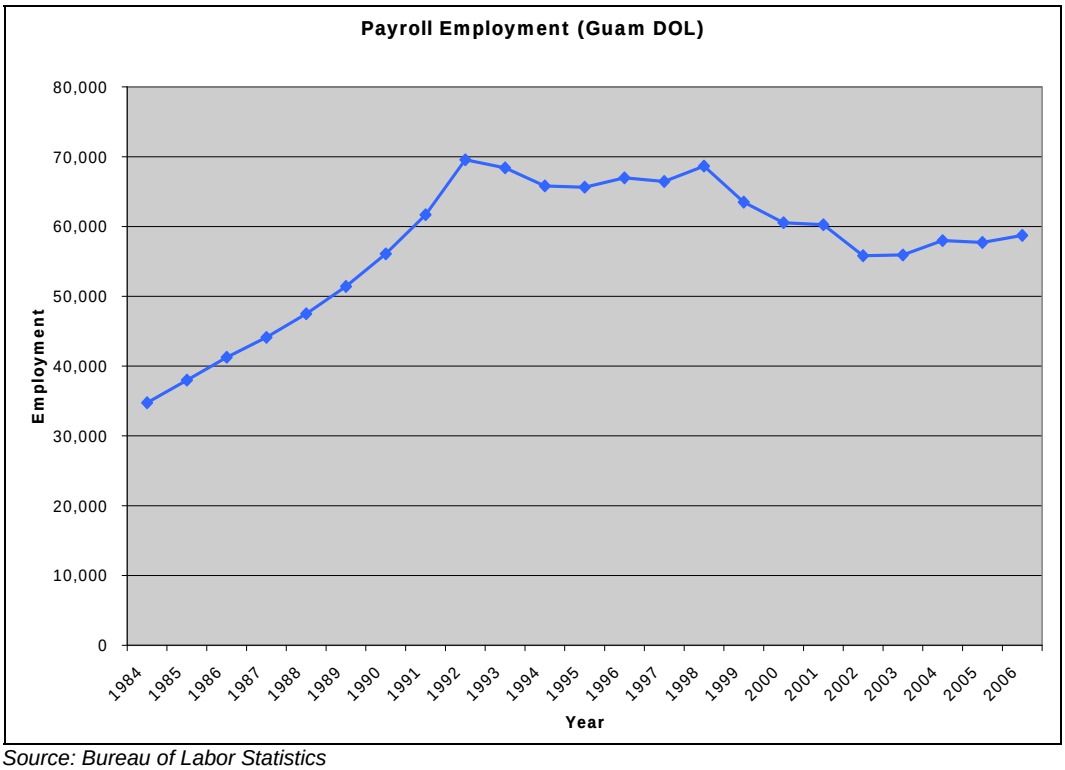


Source: U.S. Census Bureau

Tourism and military activity remain the central elements of Guam's economy. The island depends on tourists from Asian countries, mainly Japan, to drive employment and produce business revenues. Federal spending for military purposes is the other major economic generator. Given these factors, employment in the private sector is primarily based on services related to hotels and other tourism-based activities, as well as retail trade enterprises. The construction and transportation/public utilities industries are also major employment sources. Other private sector industries include agriculture, manufacturing, wholesale trade, and finance/real estate.

Employment is currently on the rise but is not yet back to earlier levels, with the number of jobs holding at approximately 65,000 in 2008. Figure 3-5 shows the number of employees on Guam from 1984 through 2006. The total number of jobs on the chart does not include military employment, which accounts for roughly 6,000 civilian jobs.

Figure 3-5: Employment on Guam (1984–2006)



Source: Bureau of Labor Statistics

3.1.2.4 Location of Existing Jobs

More than 60 percent of all non-military jobs on Guam are located in the central part of the island in the Tamuning/Tumon and Hagatna villages. Military jobs are concentrated in the northern and southwestern parts of the island in the Santa Rita and Yigo villages. Because most people live outside of these employment centers, they must commute to work. This heavy concentration of employment means that the majority of vehicles traveling during the morning and afternoon rush hours are going in the same direction, on the same roadways, causing traffic congestion. Table 3-2 shows the 19 villages on Guam in order showing the highest to the lowest number of jobs.

Figure 3-6 displays the number of jobs in each village with the main roads overlaid for reference. The darkest colored villages have the highest number of jobs.

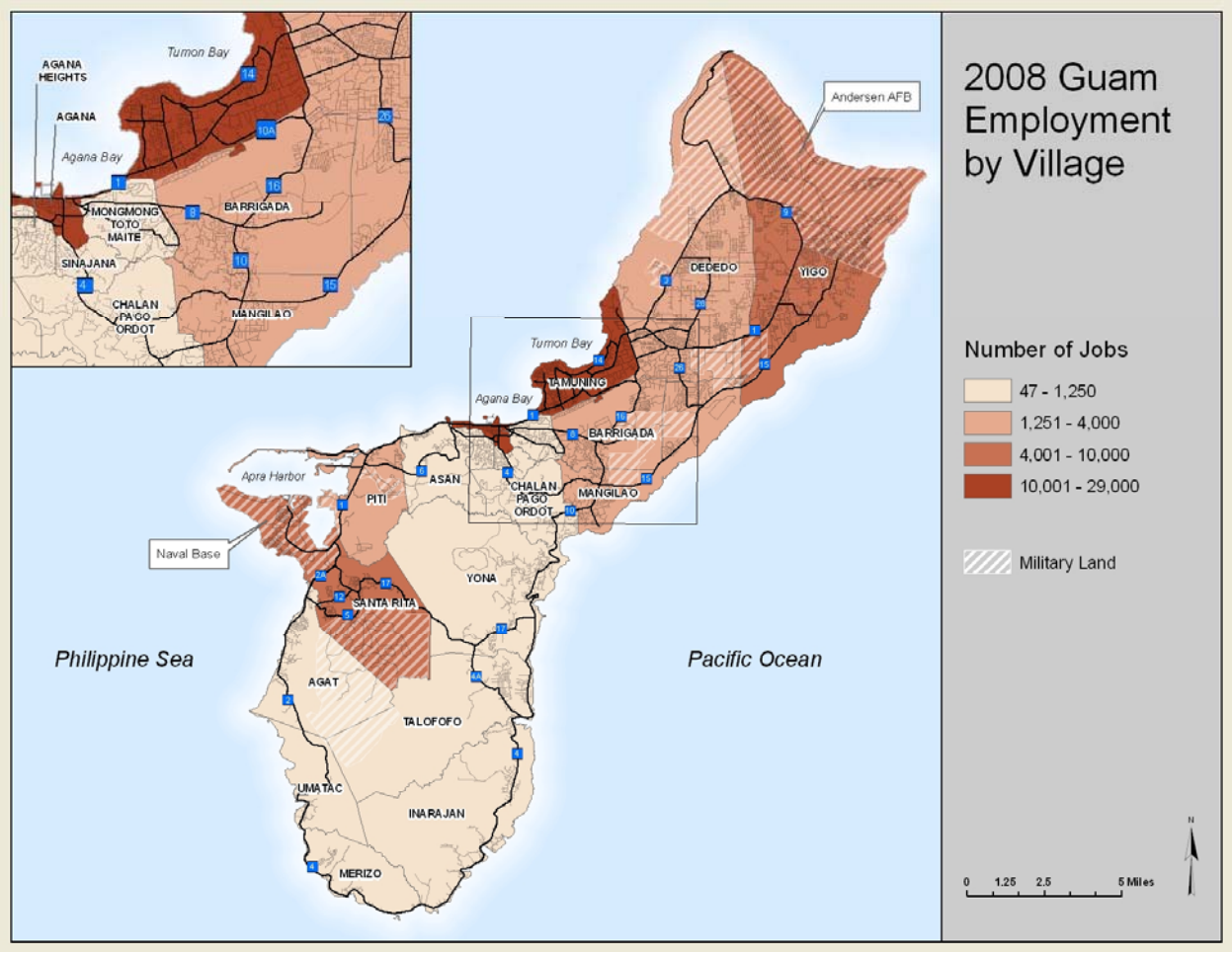
Table 3-2: Guam Employment by Village (2008)

Village	Number of Jobs	% of Total Jobs
Tamuning	28,611	45%
Hagatna	10,104	16%
Santa Rita	6,505	10%
Yigo	4,111	6%
Dededo	3,502	5%
Mangilao	2,946	5%
Barrigada	2,833	4%
Piti	1,258	2%
Mongmong-Toto-Maite	1,142	2%
Agana Heights	732	1%

Village	Number of Jobs	% of Total Jobs
Yona	696	1%
Asan	598	1%
Sinajana	302	<1%
Agat	267	<1%
Chalan Pago-Ordot	244	<1%
Inarajan	146	<1%
Talofofo	134	<1%
Merizo	81	<1%
Umatac	47	<1%
Total All Villages	**64,259**	**100%**

Source: U.S. Census Bureau

Figure 3-6: Locations of Jobs (2008)



Source: U.S. Census Bureau

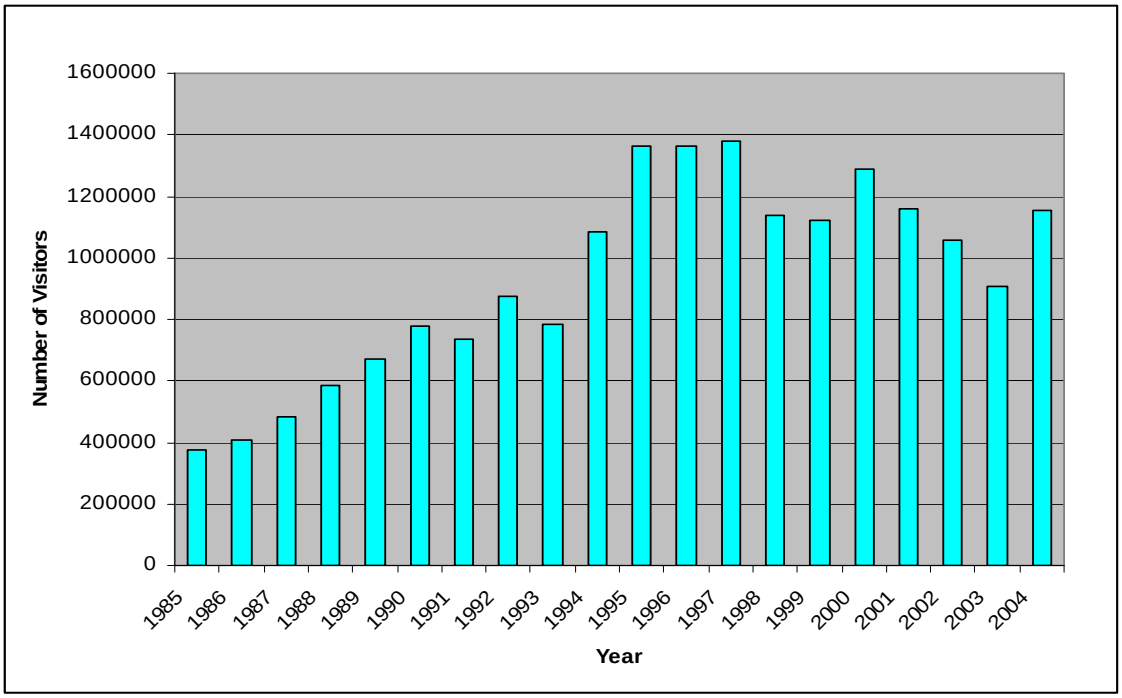
3.1.2.5 Visitors

Tourism is a central element of Guam's economy. Private sector employment is primarily based on retail and services related to the hospitality industry, including hotels, restaurants, recreational activities, and other tourism-based activities. Jobs in the real estate and construction sectors increase when tourist activity is high.

The number of visitors to the island increased during the late 1980's and early 1990's, reaching a high of more than 1.3 million visitors in 1997. In the late 1990's and early 2000's, the number of tourists began to decline at a rate of approximately 1 to 2 percent per year (Figure 3-7). In 2003, visitors were at a 10-year low of less than 910,000. The decrease in tourism occurred for a variety of reasons, some of which included natural disasters, military events, the SARS health epidemic, and the Asian financial crisis. This had a tremendous impact on Guam's economy.

Since 2003, that trend has begun to reverse. The number of visitor arrivals has increased and continues to show positive trends. In 2007, more than 1.2 million tourists vacationed in Guam, much closer to the record numbers experienced in 1997.

Figure 3-7: Total Annual Visitor Arrivals (1985–2004)



Source: Guam Visitors Bureau

Guam's tourism industry is heavily dependent on Japanese tourists. Nearly 80 percent of all visitors to Guam in 2007 were from Japan, as shown in Table 3-3. The next largest group of visitors came from South Korea, but only amounted to 10 percent of total visitors. South Korean visitors were more prevalent in the early 1990's until service air travel to Guam ceased for several years. Direct flights have

since resumed and the number of tourists from South Korea has begun to increase. Visitors from all other countries make up less than 12 percent of all visitors.

Table 3-3: Visitor Arrivals by Country (2007)

Country	Number of Visitors in 2007	% of Total Visitors
Japan	932,175	78%
South Korea	122,747	10%
U.S. Mainland	39,020	3%
Other	24,321	2%
Taiwan	21,819	2%
Commonwealth of the Northern Mariana Islands	17,661	1%
Hawaii	9,881	<1%
Philippines	8,744	<1%
Federated States of Micronesia	8,134	<1%
Hong Kong	6,224	<1%
Total	**1,190,726**	**100%**

Source: Guam Visitors Bureau

Real estate and construction revenues trend closely with tourism revenue. Hotel and resort development was prevalent during the late 1980's and into the 1990's and while tourism grew, military construction was also ongoing. In 2000, Guam's total number of building permits began to decline across all sectors, including residential, hotel, commercial, industrial, and public facilities. This was primarily due to the natural disasters and regional economic events previously mentioned.

Real estate prices sank to their lowest level in 2003 but are currently in the process of recovering with higher single-family home and condominium prices. There are also several new residential projects coming online primarily resulting from speculation related to the anticipated military build-up. Hospitality-related investments and construction permits have remained relatively flat over the last five years.

Efforts are underway that will continue the focus on the development of Guam's visitor industry, including expanding tourism from higher yield markets and expanding Guam's current visa-waiver program to encourage tourists from a wider range of countries. It is hoped that current efforts will further support Guam's upward trend in total visitor numbers.

3.2 Why Are Existing Transportation Conditions Important to the GTP?

Before new transportation projects are considered, it is important to understand how the existing system functions. Some of the questions addressed early in the planning process included:

- What purpose does the transportation system currently serve?
- Who uses the current system?
- Where are people traveling from?

- Where are people traveling to?
- What roads function well?
- Which roads are congested?
- Are there safety concerns?
- Are there a variety of ways to travel?
- How does the transit system function?
- What projects are already planned to improve the transportation system?

As these questions are answered through data analysis, on-site evaluations of traffic operations and traffic congestion, engineering and planning studies, and field inventories, it will become clear whether the transportation system is meeting the needs of the island. Areas where the system does not work well will become apparent and solutions identified to address those deficiencies.

The following sections describe the different types of transportation available on Guam, the existing conditions of each type of transportation, and the positives and negatives of the systems. This chapter, in coordination with future land-use conditions, establishes the existing conditions from which Guam's future transportation forecasts, plans, and recommended transportation improvement projects are developed.

3.2.1 Existing Transportation System

The transportation system on Guam serves many diverse needs for residents, visitors, and the U.S. military. It consists of a federal-aid highway system, village streets, a small fixed-route and demand-responsive transit service, privately operated tourist services, an airport, and civilian and military sea ports and their connections to major civilian and military destinations.

The purpose of this section is to describe the physical and operational components of the existing overall transportation system, including:

- Roadway network and bridges
- Mass transit (buses)
- Bicycle and pedestrian systems
- Waterways (harbors)
- Aviation (airports)

3.2.1.1 Roadway Network

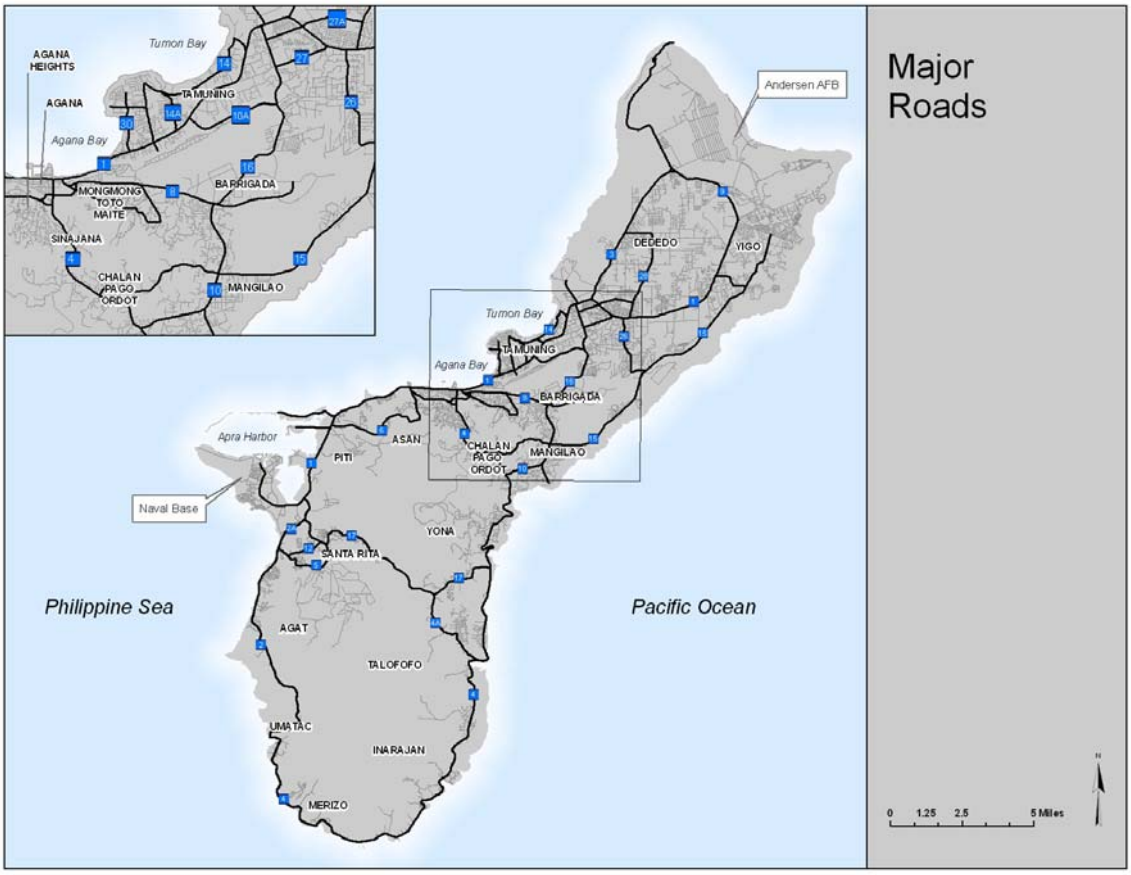
Guam's roadway system has evolved from a network of unpaved two-lane rural roads serving modest agricultural/aquaculture activity into a multi-lane roadway system serving commercial, retail, military, and tourist-based travel demands. The GDPW is responsible for the maintenance of this multi-lane roadway system comprised of 155 miles of federal-aid highway roads and 860 miles of secondary and

local roads (village streets). The village streets are collector streets and residential streets that connect residential areas to the main federal-aid highway system.

The major arterial serving Guam's travel demands is Route 1, also called Marine Corps Drive. This road stretches 22 miles from Naval Base Guam at Apra Harbor in the south to its connection with Route 9 at Andersen Air Force Base in Yigo. It is the main commercial corridor connecting residential areas to major employment centers. It also serves as a major connector for retail shopping centers, businesses, government buildings, and industrial facilities as well as the movement of goods from the Port of Guam and the Guam International Airport to the rest of the island.

Other key roads include Route 10a, which connects the Guam International Airport to Route 1, and Routes 3, 4, 8, and 16, all of which are major connectors to Route 1 from Guam's central and southern villages. Figure 3-8 shows the roads on Guam.

Figure 3-8: Major Roads on Guam



The characteristics and conditions of the roads vary across the island. Table 3-4 provides an inventory of Guam's federal-aid highways and their key characteristics. The condition of the roads is also identified in the table. Condition refers to physical condition of the road itself and does not address traffic issues, such as congestion or delay. To provide a general idea of the physical condition of the roadways, each

major highway has been categorized as one of the following: acceptable, poor or unacceptable.

- *Acceptable* indicates that the condition of the road is generally adequate for the purpose it serves, that there are no major safety or other concerns with geometrics of the road (horizontal and vertical alignments), and that the pavement is not in immediate need of resurfacing.

Table 3-4: Characteristics of Major Highways on Guam

Route #	South/West Terminus (Municipality)	North/East Terminus (Municipality)	# of Lanes	Speed Limit (mph)	Length (miles)	Pavement Condition
1	Santa Rita	Yigo	4/6	35/45	22	Varies
2	Umatac	Santa Rita	2/3	15/25/35	10	Poor
2a	Santa Rita	Santa Rita	2/4	35	1.8	Poor
3	Dededo	Dededo	2/4	35/45	5.7	Acceptable
3a	Dededo	Yigo	2	None Posted	6.1	Poor
4	Umatac	Hagatna	2/6	15/25/35	24.4	Unacceptable
4a	Talofofo	Yona	2	15/35	2.4	Poor
5	Agat	Santa Rita	2	35	1.1	Acceptable
6	Piti	Asan	2/4	25/35	4.8	Poor
7	Asan	Hagatna	2	25/35	0.8	Unacceptable
7a	Hagatna	Hagatna	2/3	15/25	0.16	Unacceptable
7b	Hagatna	Hagatna	2	None Posted	0.2	Unacceptable
8	Hagatna	Barrigada	4	35/45	4.3	Poor
9	Dededo	Yigo	2	35	3.1	Acceptable
10	Chalan-Pago-Ordot	Barrigada	2/4	25/35	3.2	Poor
10a	Tamuning	Barrigada	2/4	25/35	1.9	Unacceptable
11	Piti	Piti	2	35	2.9	Acceptable
12	Agat	Santa Rita	2	25	2.7	Poor
14	Tamuning	Tamuning	2/6	25/35	3.9	Acceptable
14a	Tamuning	Tamuning	2	None Posted	0.2	Acceptable
14b	Tamuning	Tamuning	4	None Posted	0.8	Unacceptable
15	Chalan-Pago-Ordot	Yigo	2	15/N.P.	14.2	Poor
16	Barrigada	Barrigada	4/6	35/N.P.	3.9	Poor
17	Santa Rita	Yona	2	25/35	7.4	Unacceptable
18	Piti	Piti	2	None Posted	1.4	Acceptable
26	Mangilao	Dededo	2	35	2.3	Unacceptable
27	Dededo	Dededo	6	35	1.1	Poor
27a	Dededo	Dededo	2	None Posted	2	Acceptable
28	Dededo	Dededo	2	35	3.9	Poor
29	Yigo	Yigo	2	25	1.2	Unacceptable
30	Tamuning	Tamuning	3/4	25	1.3	Acceptable
30a	Tamuning	Tamuning	4	25	0.6	Acceptable
32	Mangilao	Mangilao	2	None Posted	0.6	Acceptable
33	Hagatna	Barrigada	2	15	2.2	Unacceptable
34	Dededo	Tamuning	2	None Posted	3.6	Acceptable

- *Poor* indicates that there are minor geometric design characteristics, minor safety problems, or that the pavement is in need of repair.
- *Unacceptable* roads are those that may have major alignment issues, may lack appropriate safety features, or may have pavement in need of immediate repair.

3.2.1.2 Traffic Volumes

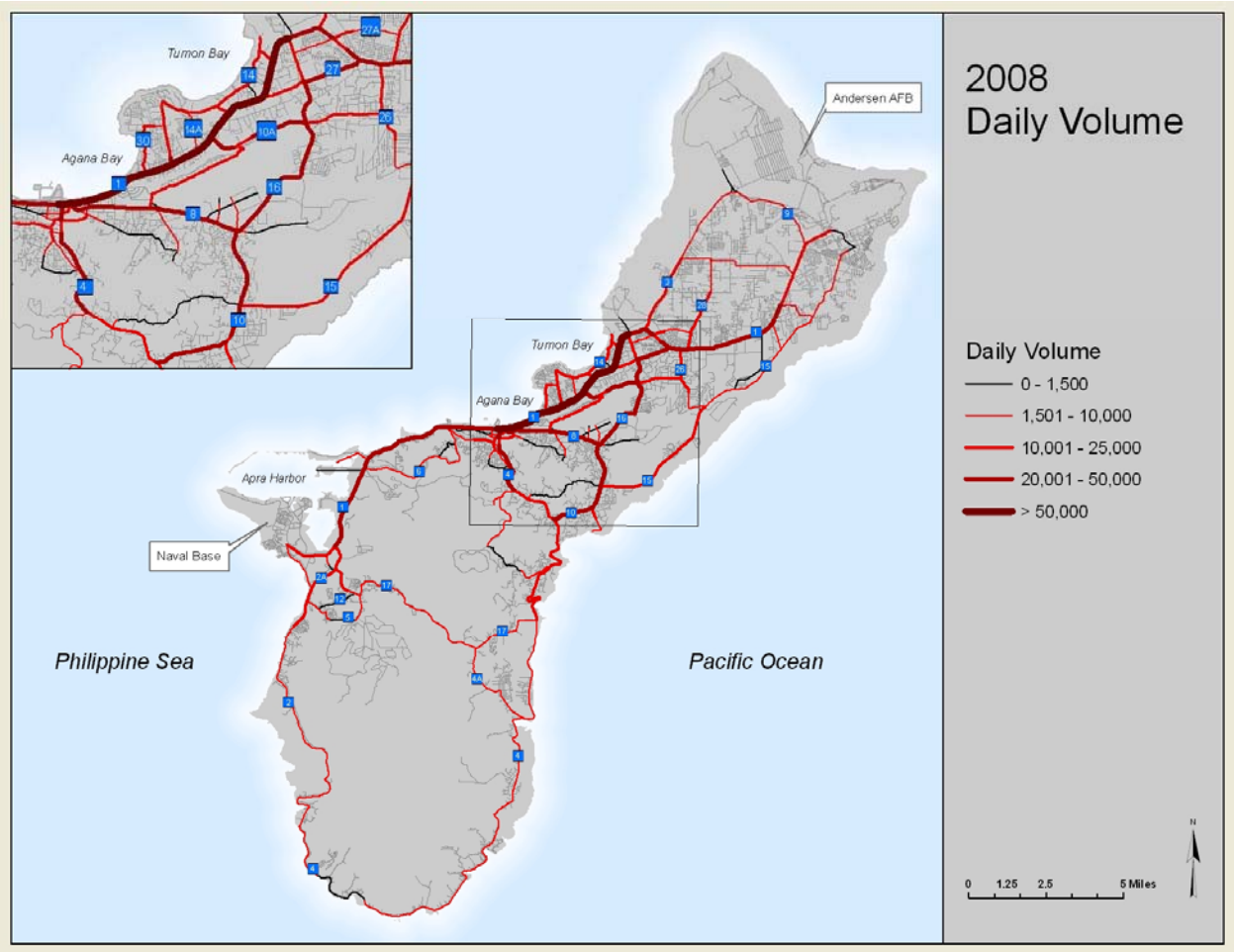
The number of vehicles traveling the roads of Guam has fluctuated over the last two decades. Traffic counts between 1991 and 1998 indicated an islandwide increase of 12.5 percent in traffic volume, but traffic counts from 1998 to 2003 indicated a decrease of 15.7 percent. The current 2008 traffic counts indicate that the overall traffic volumes have returned and surpassed the levels exhibited in the 1990s.

As shown in Table 3-5, the roads that experienced the greatest levels of traffic growth between 2003 and 2008 include Routes 1, 2, 3, 10, 14, and 16. The increases in traffic on these roads ranged from 20 to 80 percent. A few roads showed a decrease in traffic volumes but at relatively small percent decreases. Figure 3-9 shows a graphic representation of 2008 traffic volumes.

Table 3-5: Historic Traffic Volumes

Route #	From	To	1991 ADT	1998 ADT	2003 ADT	2008 ADT	% Change 2003-2008
1	Route 11	Asan Boundary	26,137	25,442	29,370	29,275	-0.3%
1	Route 4 (Paseo Loop)	Route 8	55,537	66,314	45,416	43,339	-4.6%
1	Route 14b	Route 10a	66,385	57,687	66,666	78,189	17.3%
1	Route 27	Route 26	38,755	46,275	41,568	47,895	15.2%
1	Fungo Road	Route 9	8,129	9,706	12,404	15,797	27.4%
2	Calie Marteres	Talifak Bridge	8,338	9,956	4,074	5,503	35.1%
4	Dandan Road	Asalonso Bridge	4,630	5,528	4,012	4,226	5.3%
4	Yona Boundary/Togcha Bridge	Route 17	6,627	6,332	5,792	5,585	-3.6%
10	Uog Road	Route 4 Chalan Pago	25,187	24,981	26,505	19,999	-24.5%
16	Route 10	S. Sabana Barrigada Drive	40,986	n/a	38,823	37,110	-4.4%
16	Route 10a Extension	Route 27	41,257	40,322	43,540	52,489	20.6%
8	Route 33	Route 10	35,059	n/a	40,208	41,615	3.5%
3	Route 1	Coral Tree Drive	15,169	18,072	18,520	22,704	22.6%
4a	Talofofo Boundary	San Miguel Street	2,611	3,118	2,908	2,961	1.8%
17	Bishop Baumgartner Street	Yona Boundary	2,988	3,568	2,838	3,206	13.0%
17	Paug Water Reservoir	Route 4	5,289	6,186	5,192	4,808	-7.4%
15	Route 10	Hawaiian Rock	8,726	10,891	9,975	9,803	-1.7%
15	Route 29	Mt. Santa Rosa Road	4,629	5,527	5,364	5,862	9.3%
14	Route 1 (ITC)	Route 30a	28,039	36,178	22,691	20,095	-11.4%
14	Route 14b	Route 14a	30,171	36,026	14,973	27,088	80.9%
14	Okura Access Road	Route 1	19,059	26,313	16,163	22,817	41.2%

Figure 3-9: Average Daily Traffic (2008)

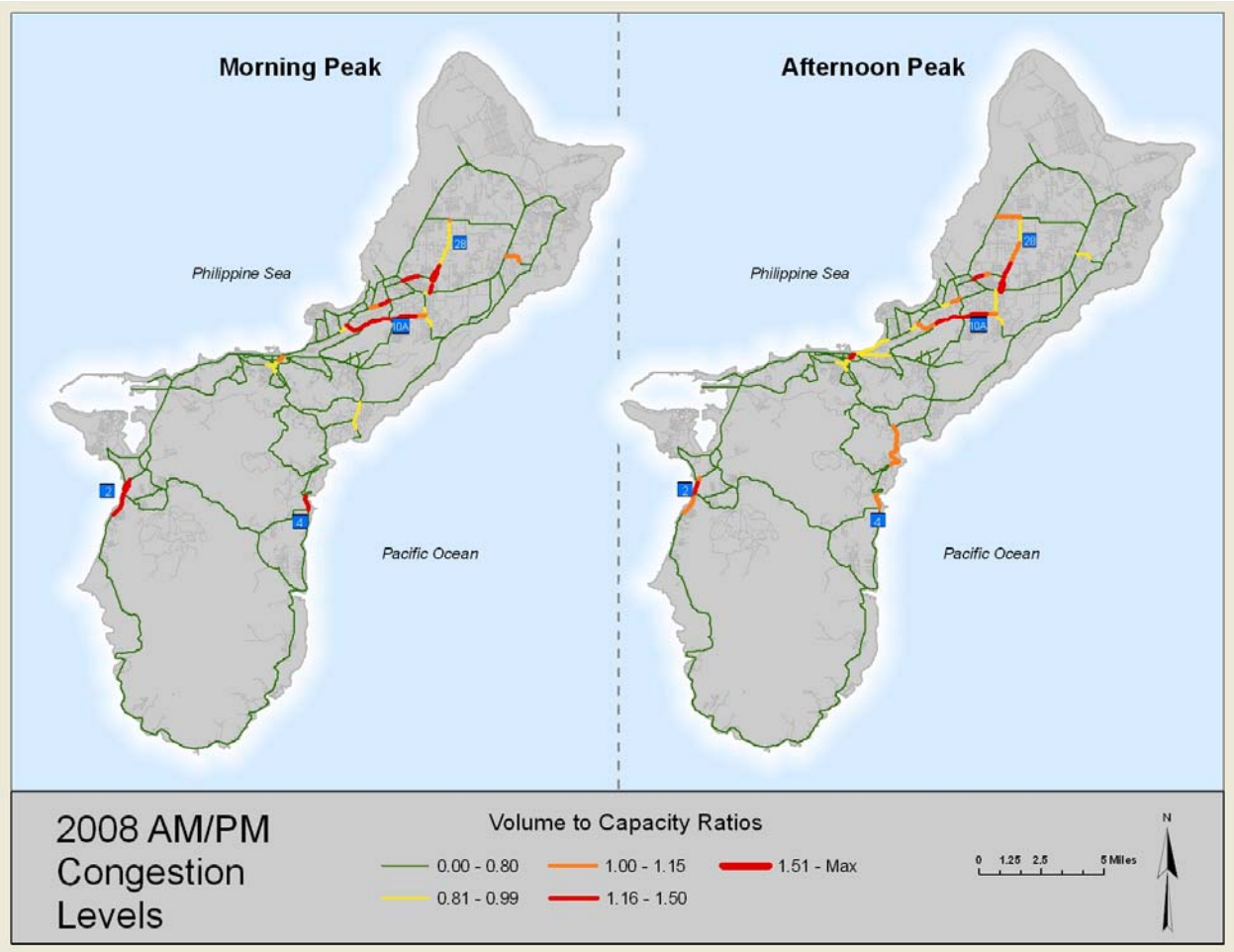


3.2.1.3 Traffic Congestion

Traffic congestion is measured by dividing the number of cars on the road (volume) by the number of cars the road was designed to carry (capacity). A volume-to-capacity (v/c) ratio greater than 1 indicates that the roads are carrying more vehicles than they were designed to handle—the roads are congested.

Transportation modeling analysis was conducted to simulate existing transportation conditions on the island. The Guam travel demand model was run with the 2008 population and employment numbers and congestion levels were calculated. Figure 3-10 shows existing levels of traffic congestion on Guam. Segments that are shown in orange and red lines represent roadways that have more traffic on them than they are designed to handle.

Figure 3-10: Roadway Congestion (2008)



The roads serving major residential and employment centers, such as Dededo and Tamuning, are currently the most congested. These roads are also roads that would be heavily used by the military. During both the morning and afternoon peak, the roads with the greatest congestion levels are:

- Routes 27, 27a, and 28 (Dededo)
- Route 29 (Yigo)
- Route 10a (Tamuning/Barrigada)
- Route 2 (Agat)
- Route 4 (Yona)

Of particular note is that the model does not show congestion along Route 1 through Tamuning even though many vehicles travel this roadway. This is because the roadway segments are designed to handle the high volume of traffic they presently serve. Even though there are many cars on the road, it does not exceed its design capacity and is, therefore, not technically “congested” (Figure 3-11). The delay that

drivers experience on Route 1 results from poor operations, such as traffic signal timing.

While these congested locations are undesirable under present traffic conditions, of issue is what is going to happen when thousands of new military personnel, dependents, and workers, as well as slow moving trucks and equipment are added to the daily traffic movements.

Figure 3-11: Route 1 without Traffic (Off-Peak)

3.2.1.4 Effectiveness of Existing Roadway System

The effectiveness of roadways can be measured in a variety of ways. The Guam travel demand model was used to determine roadway function by analyzing four key factors:

- Vehicle miles traveled
- Vehicle hours traveled
- Delay
- Speed

Table 3-6 shows vehicle miles traveled (VMT), vehicle hours traveled (VHT), hours of delay (VHD) and the speed at which vehicles are traveling. These measures are outputs of the travel demand model which will be discussed in greater detail in subsequent chapters. This table serves as a baseline from which to measure the future performance of the roadway system.

Table 3-6: Performance Measures of Guam Roads

Measure of Effectiveness	2008 Existing System
Morning Peak Hour	
Vehicle Miles	213,281
Vehicle Hours	7,475
Delay (hours)	358
Speed (mph)	29
Afternoon Peak Hour	
Vehicle Miles	227,131
Vehicle Hours	7927
Delay (hours)	342
Speed (mph)	29
Off-Peak Hours	
Vehicle Miles	147,420
Vehicle Hours	4,982
Delay (hours)	49
Speed (mph)	30
Daily Totals	
Vehicle Miles	264,9864
Vehicle Hours	90,589
Delay (hours)	1,991
Speed (mph)	29

3.2.1.5 Maintenance

The majority of the roadways on Guam are in need of varying levels of maintenance and a proactive, recurring maintenance program. These maintenance issues range from deteriorated asphalt and recurring potholes to safety guardrails, striping, and reflectors. Efforts are now underway to focus on many of these issues through the TTIP. However, these projects are primarily focused on federally funded roadways, and there are a host of maintenance issues that need to be addressed for locally funded village streets. Some of the major maintenance areas are:

- Paving or repaving
- Signs and markings
- Right-of-way maintenance (including guard rails)
- Traffic signal maintenance
- Surveillance, inspections, and repair (if not already included in the TTIP as a specific bridge or re-paving project)
- Street lighting

Figure 3-12 provides just two of many possible examples of roadways with deteriorated pavement conditions. This will be of particular concern during the military build-up construction activities due to the additional traffic and heavy military and military-related construction vehicles that will be using roads already in poor condition.

Figure 3-12: Sample Deteriorated Pavement Conditions

3.2.1.6 Traffic Operations

From a traffic-operations perspective, much of the roadway system operates reasonably well. During the morning and afternoon peak hours, some segments operate poorly in Tamuning and Dededo. This poor performance is primarily due to inefficiently timed and uncoordinated traffic signals (Figure 3-13). Inoperable traffic sensing loops and pedestrian push buttons cause unnecessarily long delays at traffic signals. Additionally, left turns from main roads at traffic signals are protected-only (meaning they are only allowed on green arrows) and most side street traffic is only allowed through major intersections one direction at a time. In some cases, it may be reasonable to allow left-turns during the normal green lights, reducing delay and increasing efficiency at signalized intersections. Locations for these left-turns should be very carefully considered to provide the highest level of safety possible while improving the operational efficiency of the traffic signals. Guam could dramatically improve traffic operations and reduce traffic delays through a concerted effort to upgrade traffic signal timing equipment.

One example of individual intersection performance along a corridor is shown in Table 3-7. Route 1, the major north-south road on Guam, was assessed to determine the average length of delay at intersections and the resulting level of service (LOS). LOS is ranked on a scale of A–F, with scores A–D representing acceptable levels of delay. LOS E and F are considered unacceptable and indicate severe traffic congestion. Route 1 intersections with Route 14 (ITC), Route 10a, GTA, and Route 3 currently operate at unacceptable levels.

Figure 3-13: Sample Traffic Signal

Table 3-7: Intersection Operations Analysis—Route 1 (Segment 2)

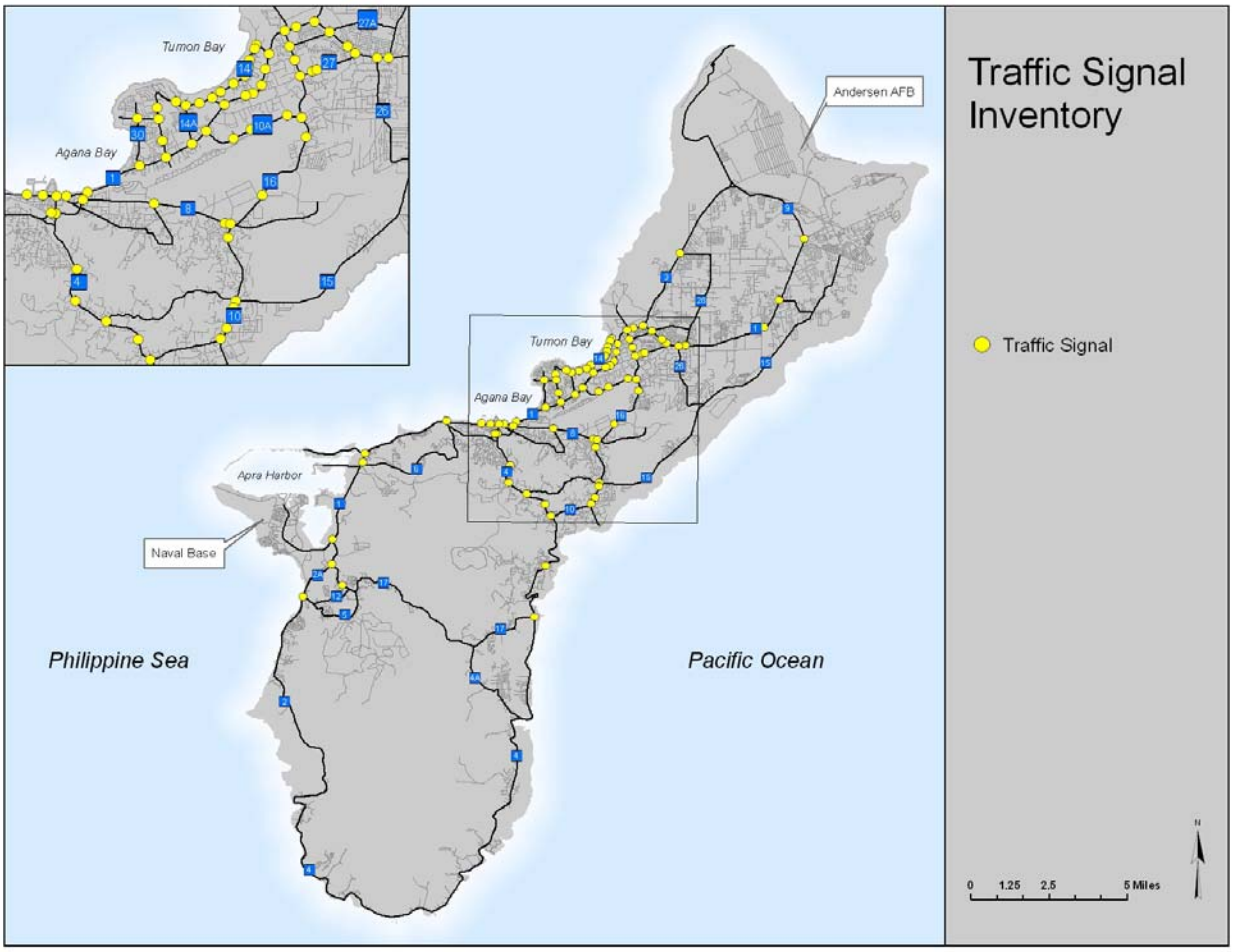
Route 1 Intersection (Segment 2)	Existing Condition (2008)	
	Delay (seconds/vehicle)	Level of Service
Route 30	51.1	D
Route 14 (ITC)	136.3	F
Route 14b	33.5	C
Route 10a	81.5	F
Route 14a (K-Mart)	54.5	D
DPW	11.6	B
GTA	58.2	E
St. John School	38	D
Pia Marine	10.1	B
Route 14 (Upper San Vitores)	44.2	D
Route 16	40.5	D
Micronesia Mall Exit	10.9	B
Route 3	62.4	E

Note: Shading indicates intersections operating at unacceptable levels.

Traffic Signals

There are 78 traffic signals along various roadways on Guam, the majority of which are found in Tamuning and the surrounding central region (Figure 3-14). All traffic signals currently run independent of each other (free).

Figure 3-14: Traffic Signal Inventory

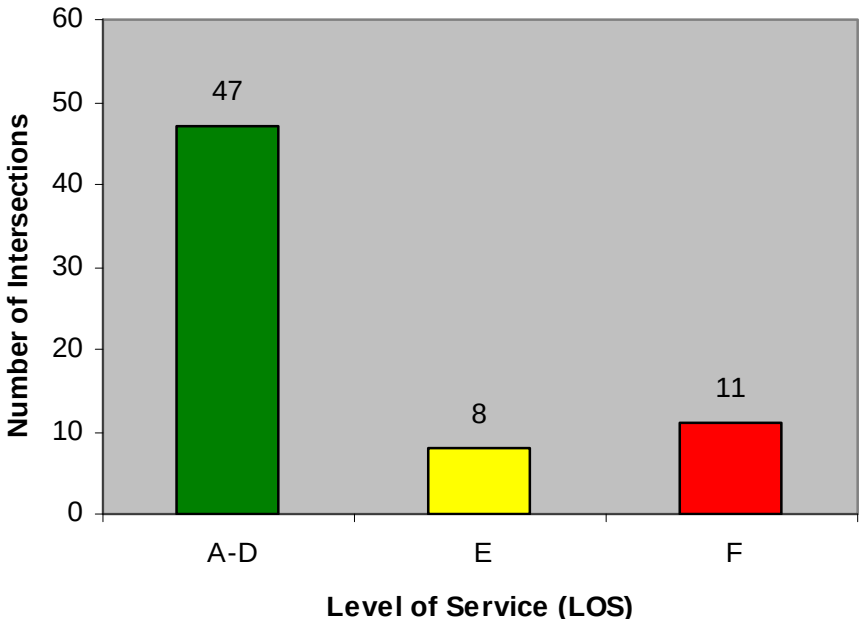


In order to assess the efficiency of the signal system, peak hour traffic counts were collected, geometric conditions were analyzed and existing timing information was obtained from GDPW. Below are a few general observations:

- Signals operate safely but many require maintenance
- Some approaches lack the minimum two indications as required by the Manual on Uniform Traffic Control Devices (MUTCD)
- Some locations have non-functioning traffic loops and pedestrian buttons

The results of the analysis indicate that the traffic signal system on Guam functions at a low level of efficiency. As shown in Figure 3-15, almost 30 percent of the traffic signals evaluated operate with a poor LOS (E or F). The traffic signals are not coordinated along the busiest corridors of the road network. Simple time-of-day maximum time changes are used to alleviate problems during peak conditions but are an ineffective alternative to traffic signal coordination.

Figure 3-15: Traffic Signal Level of Service



Additionally, while the MUTCD requires two indications at an approach, there are numerous intersections with only one. Inoperable traffic sensing loops and pedestrian push buttons allow unnecessary prolonged signal phases. Pedestrians receive inadequate notice or time to safely cross streets. Left turns at traffic signals are almost exclusively "protected-only." Main streets are primarily "protected-only" and most side streets are "split phase" to eliminate permissive left turns.

Traffic Management Center

Construction began in 2000 for a new Traffic Management Center (TMC) to improve the efficiency of the roadway system. The TMC would have provided office space for the base of operations, computers and monitors, using the BiTran QuickNET 4 system software. New field equipment was planned for 19 locations, including controllers (170E-BiTran), video, and video detectors. Aerial fiber backbone was to be mounted on utility poles.

In 2003, the project was 90 percent complete when a typhoon destroyed the aerial fiber backbone and all work on the TMC stopped. The traffic signal coordination plans were not implemented, documentation and training were not completed, and operations and staffing plans were not developed. Recently, discussion of this topic has been revived, and GDPW is assessing the most appropriate next steps.

Examples of Problems at Intersections

In addition to problems related to traffic signal timing and roadway performance, there are a number of other intersection-related issues due to either design or implementation deficiencies. Following are a few examples of some of the issues that cause poor roadway performance.

Route 1/Route 18

- Fourth highest crash location (2004, 2005)
- Stop sign has poor visibility (Figure 3-16)
- Northbound left-turn lane needs improvement
- Traffic signal may be warranted

Route 5/Route 17

- Drainage structure in clear zone (Figure 3-17)

Route 15/Route 29

- Sight distance problems

Route 27a/Route 28

- Busy multi-way stop sign controlled intersection near school

Figure 3-16: Route 1/Route 18 Sample Stop Sign Visibility

Figure 3-17: Route 1/Route 18 Sample Drainage Structure in Clear Zone

Signage

The placement of speed limit signs, if not done correctly, can also cause problems that impact the functioning of the roads. For example:

- Route 1 near Route 29—speed limit posted at 35 miles per hour (mph) in northbound direction and 45 mph in southbound direction
- Route 1 near Route 18—speed limit posted at 45 mph for a short distance
- Route 10 south of Route 8—speed limit posted at 20 mph on this major roadway
- Route 15 south of Route 29—the normal speed of 35 mph drops to 20 mph

Stripings and Markings

It is important to maintain the stripings and marking on the roads. However, many of Guam's roads are generally in poor condition as it relates to striping/marking. Only 12 percent of the roads are in good condition, the remaining 88 percent are in poor condition. There has recently been a contract developed to restripe and/or remark federal roadways and intersections. The ability to execute this project is contingent upon right-of-way issues. Figure 3-18 shows an example of striping on Route 26 that is so worn it is almost undetectable.

Figure 3-18: Existing Striping on Route 26

3.2.1.7 Bridges

The GDPW maintains 36 bridges throughout the island. Although bridge construction dates from 1930 to as recent as 1995, the majority of the bridges (72 percent) were built during the 1970s and 1980s. The bridges were inspected in 2004 by the FHWA and rated on a scale of 1 to 5 ("structurally sound" to "needs replacement") for their structural integrity. Eight bridges on the list in Table 3-8 have a rating of 4 or 5, indicating that attention is required. These include Agana Bridge #1, Ajayan Bridge, Aplacho Bridge, Atantano Bridge, Bile Bridge, Pigua Bridge, Umatac Bridge, and Ylig Bridge. Improvements to all of these bridges, with the exception of the Umatac Bridge, are currently programmed in the FY2008–2011 TTIP.

Table 3-8: Bridge Listing

Structure Name	Location (Route)	Main Structure Type	Number of Lanes	Year Built or Rebuilt	Structural Rating
Agana Bridge #1	1	Frame	6	1945	4
Agana Bridge #2	Chalan Santo Pablo Juan Pablo	Tee beam	2	1969	3
Agfayan Bridge	4	Multi-beam	2	1978	2
Agueda Bridge	1	Culvert	4	1960, 1987	3
Ajayan Bridge	4	Box girder (single)	2	1968	5
Aplacho Bridge	17	Multi-beam	2	1960	4
Asan Bridge (Inland) #1	Ramona Street	Slab units (multiple)	1	1985	1
Asan Bridge (Inland) #2	Tydingco Street	Slab units (multiple)	2	1985	2
Asan Bridge (Marine Drive) #1	1	Culvert	4	1970, 1983	2
Asan Bridge (Marine Drive) #2	1	Culvert	4	1985	3
As-Linget Bridge	4	Culvert	2	1985	3
Atantano Bridge	1	Tee beam	4	1970	4
Bile Bridge (Formerly 31a)	4	Multi-beam	2	1930	5
Chaot Bridge	4	Multi-beam	2	1977	2
Fonte Bridge	1	Frame	6	1982	2
Geus Bridge	4	Slab units (multiple)	2	1982	3
Inarajan Bridge (North Leg)	4	Multi-beam	2	1978	3
Inarajan Bridge (South Leg)	4	Multi-beam	2	1977	1
Laguas Bridge (Formerly 2a)	1	Multi-beam	4	1985	2
Lygog Bridge	4	Multi-beam	2	1976	3
Masso Bridge	6	Culvert	4	1980	1
Minondo Bridge	7	Multi-beam	2	1988	3
Namo Bridge	2	Frame	2	1973	1
Overpass Bridge	16	Tee beam	6	1990	1
Pago Bridge	4	Multi-beam	3	1984	2
Pauliloc Bridge	4	Tee beam	2	1972	2
Pigua Bridge (Formerly 31b)	4	Other	2	1930	5
Santa Rita Bridge	12a	Tee beam	2	1972	3
Sasa Bridge (Formerly 2b)	2	Multi-beam		1985	3
Sumay Bridge	4	Multi-beam	2	1972	1
Talifak Bridge	2	Frame	2	1975	2
Talofofo Bridge	4	Multi-beam	2	1979	3
Togcha Bridge	4	Tee beam	2	1972	2
Toguan Bridge	4	Multi-beam	2	1995	3
Umatac Bridge	4	Multi-beam	2	1985	4
Ylig Bridge	4	Multi-beam	2	1968	5

Note: Shading indicates projects in the TTIP.

3.2.2 Mass Transit

The purpose of this section is to present an inventory and assessment of current mass transit services on Guam and to identify unmet transit needs and opportunities. The information presented in this chapter is drawn from the *Draft Conditions Assessment and Baseline for 2030* mass transit plan submitted in April 2008.

Residents of Guam rely on their own cars as their primary means of transportation. Transit use is low and personal vehicle ownership is high. According to the 2000 Census, only 7 percent of Guam households had no car available.

Public transportation on Guam includes the following modes and service types:

- Tour buses (motor coaches that carry tourists between hotels and major tourist destinations or provide sightseeing tours)
- Shopping buses (trolley-style or conventional buses that connect tourists with shops, restaurants, or other activities)
- Taxis (there are about 300 on Guam)
- School buses
- Special service for Navy shore leave
- Guam Mass Transit
    - Fixed-route (buses on designated routes at prescribed headways)
    - Demand-response (reservation-type service linking residential areas with fixed-route service or nearby activity centers)
    - Paratransit (service for disabled)

3.2.2.1 Description of Guam Mass Transit

The Guam Mass Transit services are provided by a private bus operator, Kloppenburg Enterprises, Inc. Kloppenburg, which also operates some of the shopping and tour buses, has responsibility for Guam Mass Transit services through month-to-month purchase orders given by the Government of Guam Department of Administration, Division of Public Transportation Services. The purchase order arrangement is an interim situation requiring early action to establish a stable and on-going means of providing service. This absence of any long-term contract makes procurement of new vehicles or other capital investment on the part of the contractor unsuitable because of the risk of making unrecoverable investments if use of the contractor is discontinued.

Kloppenburg Enterprises shares the provision of Guam Mass Transit services with two other bus operators, Sanko and Micronesian. The service provided is compensated under the monthly purchase orders on the basis of vehicle hours operated. The current rates for mass transit service, including the cost of fuel and tires as well as other operating and maintenance costs, are $47 per hour for demand-response, $45 for fixed-route, and $52 for paratransit. Rates in effect during fiscal year (FY) 2007 are shown elsewhere in this report. The service is provided with a total of about 25 buses in service on weekdays, including 5 to 7 provided by Sanko, generally 10 by Kloppenburg, and the remainder by Micronesian. These are provided out of a total available fleet of 32 vehicles.

3.2.2.2 Guam Mass Transit Routes and Schedules: Fixed-Route

Figure 3-19 illustrates the current Guam Mass Transit fixed routes and demand-response service areas. Note that all the Monday–Friday fixed routes originate at Chamorro Village. The fixed-route service schedules are provided in Table 3-9.

Figure 3-19: Existing Transit Routes

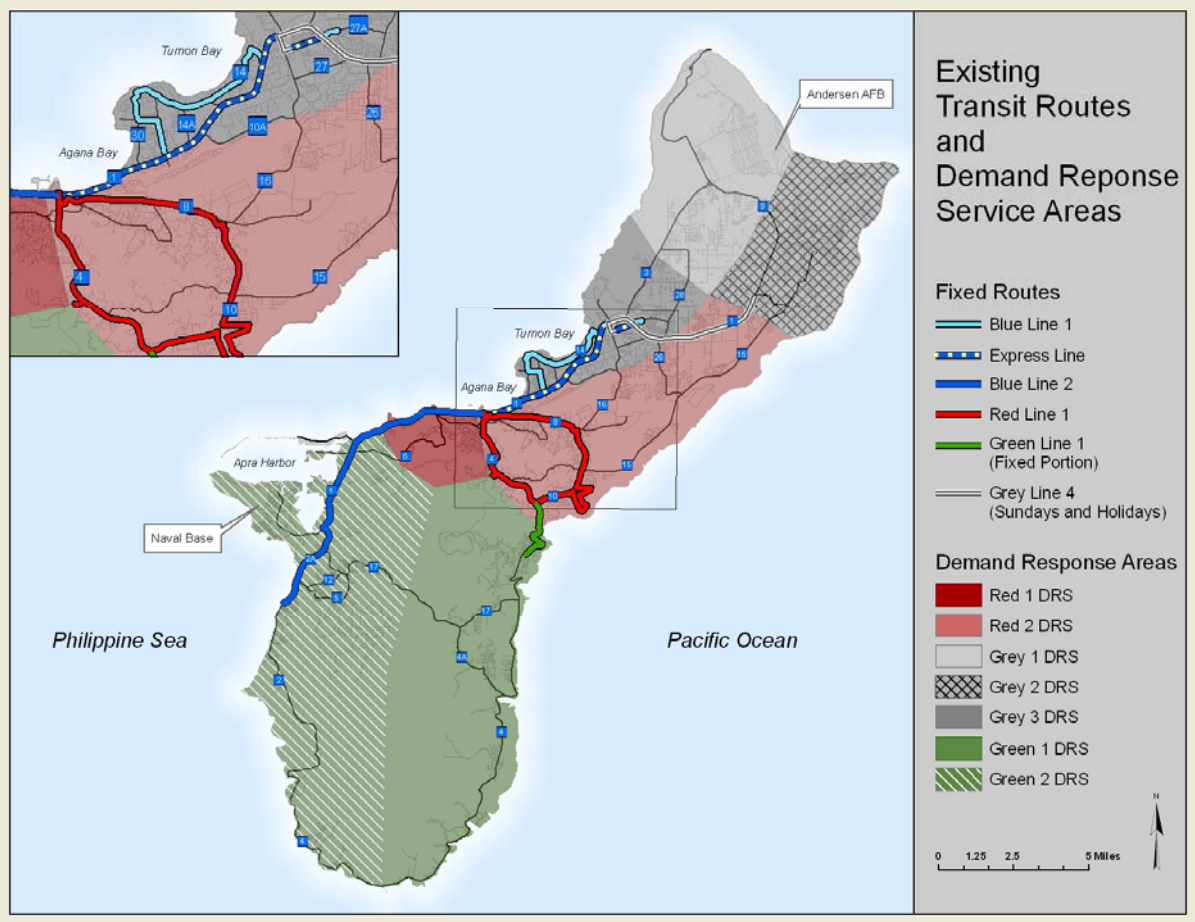


Table 3-9: Guam Mass Transit Fixed-Route Service Description

Route	Areas Served	Headway (hours)	Trips per Day, Monday-Saturday	Trips per Day, Sunday/Holiday	Scheduled Run Time Outbound (minutes)	Scheduled DR Time (minutes)	Scheduled Run Time Inbound (minutes)
Blue Line 1	Hagatna—Tumon—Micronesia Mall (Shuttle)	2	8 OB, 6 IB	6	41 to 52		44 to 54
Blue Line 2	Hagatna—Agat (Shuttle)	2	8 OB, 6 IB	5 OB, 4 IB	35 to 37		32 to 35
Red Line 1	Hagatna—Mangilao (Loop)	1	14	9	22 to 28		28 to 37
Express Line	Hagatna—Micronesia Mall (Loop)	1	13.5	9	25 to 37		28
Green Line 1*	Chamorro Village—Yona (Loop)	2	8	0	10	80	20
Grey Line 4*	Micronesia Mall—Yigo (Loop)	2	0	5	39 to 40	20 to 21	48 to 49

Source: Government of Guam, Department of Administration, Division of Public Transportation Services.
OB = outbound, IB = inbound
*Hours of service are 5:30 a.m. – 7:30 p.m. Monday through Saturday and 7:30 a.m. – 5:30 p.m. Sundays and Holidays.

Some of the routes were examined to check schedule adherence, with the finding that scheduled times in most cases far exceed realistic running times. As a result, buses that leave a trip beginning point on time are almost immediately ahead of schedule. Normal operating practice appears to be to continue at a comfortable speed rather than deliberately slowing or stopping the vehicle at a time point to maintain schedule. As a result, buses typically run well ahead of schedule and arrive at each trip destination long before the scheduled arrival time. This practice results in passengers being unable to rely upon published timetables. The excess time allowances in the timetables also result in substantial quantities of wasted vehicle hours.

Green Line 1 operates as a fixed route between Chamorro Village and Yona. South of Yona it provides demand-response service to Talofofo, Malojloj, and Inarajan. Grey Line 4 operates as a fixed route between Micronesia Mall and Yigo. South of Yigo it provides demand-response service.

In addition to routes Green Line 1 and Grey Line 4, which share demand-response service with fixed-route service, there are six services providing demand-response service exclusively. These routes provide service on Monday through Saturday only, and all observe the normal 5:30 a.m. to 7:30 p.m. hours of service. Demand-response service is available on call and normally provides transportation to the nearest fixed-route. The six demand-response services are as follows:

- Northern shuttles
  - Grey Line 1, serving Dededo, Agata Gumas, Santa Ana, and vicinity
  - Grey Line 2, serving Yigo, Latte Heights, and vicinity
  - Grey Line 3, serving Tamuning, Tumon, Harmon, and vicinity
- Central shuttle
  - Red Line 2, serving Hagatna, Anigua, Maina, and vicinity

- Southern shuttles
  - Green Line 1, serving Hagatna, Yona, Talofofo, Malojloj, and Inarajan
  - Green Line 2, serving Agat, Santa Rita, Umatac, and Merizo

3.2.2.3 Guam Mass Transit Routes and Schedules: Paratransit Service

Paratransit service provided by Guam Mass Transit supplies door-to-door transportation for persons with certified disabilities and is available by advance reservation. Hours of operation are 5:30 a.m. to 7:30 p.m., Monday through Saturday, and 7:30 a.m. to 6:30 p.m. on Sundays and holidays.

There are four paratransit services:

- Freedom 1 (northern area) serving Yigo, Agafa Gumas, NCS, Santa Ana Subdivision, Astumbo, Dededo, Harmon, and Tamuning
- Freedom 2 (central area) serving Hagatna, Agana Heights, Sinajano, Chalan Pago, Pago Bay, Mong Mong, and Tamuning
- Freedom 3 (southern area) serving Inarajan, Malojloj, Talofofo, and Yona
- Freedom 4 (southern area) serving Umatac, Agat, Piti, Asan, Maina, Agana Heights, and Hagatna

3.2.2.4 Guam Mass Transit Ridership, Cost, and Fare Revenue

The most recent full year of Guam Mass Transit operations data is for FY2007, the period October 2006 through September 2007. Table 3-10 provides ridership results by month for this 12-month period. Passenger boardings are tabulated for each route of the three service types: demand-response, fixed-route, and paratransit.

Table 3-10: Monthly and Total Fiscal Year 2007 Guam Mass Transit Ridership (Passengers Boarding Each Route)

Service Type	Route Name	Oct 2006	Nov 2006	Dec 2006	Jan 2007	Feb 2007	Mar 2007	Apr 2007	May 2007	Jun 2007	Jul 2007	Aug 2007	Sep 2007	12-Month Totals
DR	Red 2	1,921	1,596	1,114	1,805	1,724	2,203	1,972	2,099	1,876	1,669	1,554	1,775	21,308
	Grey 1	2,857	2,341	2,217	2,316	2,462	2,658	2,808	2,886	2,850	2,442	2,543	2,443	30,823
	Grey 2	2,383	1,961	2,714	1,842	1,919	1,907	2,287	2,022	2,323	1,993	1,961	2,119	25,431
	Grey 3	785	983	1,083	1,020	996	995	1,132	1,133	1,250	701	763	985	11,826
	Green 1	1,206	1,004	1,114	1,093	1,065	1,305	1,202	1,015	873	923	985	1,265	13,050
	Green 2	610	673	712	817	800	859	776	983	926	692	889	932	9,669
MB	Blue 1	3,093	3,027	2,714	2,817	2,518	2,996	2,054	2,080	2,148	1,989	2,069	2,500	30,005
	Blue 2	1,154	1,204	1,083	1,357	1,252	1,119	1,202	1,521	1,409	1,095	1,235	1,239	14,870
	Express	3,563	3,472	3,250	3,358	3,167	3,608	3,337	3,555	2,869	3,022	2,891	3,218	39,310
	Red 1	2,494	2,398	2,217	2,132	2,274	2,442	2,194	2,292	2,198	1,745	2,016	2,218	26,620
	Grey 4	57	110	108	68	24	52	41	55	0	0	0	47	562
Para	F1	745	689	710	746	660	681	655	759	597	512	698	677	8,129
	F2	747	665	680	704	705	599	629	704	564	558	637	654	7,846
	F3	515	465	559	576	1,118	608	411	455	443	466	552	560	6,728
	F4	639	761	672	682	739	907	698	787	743	679	844	741	8,892
	F5	496	597	540	594	548	620	519	526	465	460	616	543	6,524
DR	Totals	9,762	8,558	8,954	8,893	8,966	9,927	10,177	10,138	10,098	8,420	8,695	9,519	112,107
MB	Totals	10,361	10,211	9,372	9,732	9,235	10,217	8,828	9,503	8,624	7,851	8,211	9,222	111,367
Para	Totals	3,142	3,177	3,161	3,302	3,770	3,415	2,912	3,221	2,812	2,675	3,347	3,175	38,109
All	**Totals**	**23,265**	**21,946**	**21,487**	**21,927**	**21,971**	**23,559**	**21,917**	**22,862**	**21,534**	**18,946**	**20,253**	**21,916**	**261,583**

Table 3-11 provides the operating and maintenance costs incurred in providing Guam Mass Transit services during FY2007. Table 3-12 provides a calculation of average operating and maintenance cost per passenger boarding for each of the three service types and for all services combined.

Table 3-11: Monthly and Total Fiscal Year 2007 Guam Mass Transit Cost (U.S. Dollars)

Period (Month)	DR	MB	Paratransit	Subtotal	Pre-Employment Tests	Total
Oct 2006	97,319.04	77,264.32	99,418.00	274,001.36	3,480.00	277,481.36
Nov 2006	92,166.15	77,477.50	89,766.18	259,409.83	3,540.00	262,949.83
Dec 2006	94,465.80	81,648.00	92,533.38	268,647.18	4,140.00	272,787.18
Jan 2007	98,898.00	79,632.00	93,111.90	271,641.90	3,656.95	275,298.85
Feb 2007	90,223.02	72,576.00	86,345.28	249,144.30	3,481.00	252,625.30
Mar 2007	100,438.24	78,333.12	96,155.64	274,927.00	3,378.00	278,305.00
Apr 2007	89,534.88	73,356.79	91,170.00	254,061.67	3,100.50	257,162.17
May 2007	95,996.54	78,330.56	98,470.00	272,797.10	3,209.10	276,006.20
Jun 2007	91,873.49	63,913.20	89,310.00	245,096.69	3,805.00	248,901.69
Jul 2007	82,015.48	61,455.00	84,018.75	227,489.23	2,613.75	230,102.98
Aug 2007	97,200.00	66,136.80	87,925.50	251,262.30	2,972.50	254,234.80
Sep 2006	81,814.10	65,925.00	80,036.70	227,775.80	2,767.50	230,543.30
Total	**1,111,944.74**	**876,048.29**	**1,088,261.33**	**3,076,254.36**	**40,144.30**	**3,116,398.66**

Source: Government of Guam, Department of Administration, Division of Public Transportation Services.
Notes: DR = Demand-Response, MB = Fixed-Route (Motor Bus), Para = Paratransit (service for persons with disabilities).

Table 3-12: Monthly and Total Fiscal Year 2007
Guam Mass Transit Cost per Passenger Boarding

Period (Month)	DR	MB	Paratransit	Total
Oct 2006	$9.97	$7.46	$31.64	$11.78
Nov 2006	$10.77	$7.59	$28.26	$11.82
Dec 2006	$8.52	$8.71	$29.27	$11.37
Jan 2007	$11.12	$8.18	$28.20	$12.39
Feb 2007	$10.06	$7.86	$22.90	$11.34
Mar 2007	$10.10	$7.67	$28.16	$11.66
Apr 2007	$8.80	$8.31	$31.31	$11.59
May 2007	$9.47	$8.24	$30.35	$11.92
Jun 2007	$9.10	$7.41	$31.76	$11.38
Jul 2007	$9.74	$7.83	$31.41	$12.01
Aug 2007	$11.18	$8.05	$26.27	$12.41
Sep 2006	$8.59	$7.15	$25.21	$10.39
Total Year	**$9.73**	**$7.87**	**$28.54**	**$11.66**

Source: Parsons Brinckerhoff from data provided by Government of Guam, Department of Administration, Division of Public Transportation Services.
Notes: DR = Demand-Response, MB = Fixed-Route (Motor Bus), Para = Paratransit (service for persons with disabilities).

Table 3-13 lists monthly fare revenues during FY2007. Although the normal single fare is $1.00, the average fare revenue is approximately $.50 per passenger boarding due to various discounts and passenger transfers.

Table 3-13: Monthly and Total Fiscal Year 2007
Guam Mass Transit Fare Revenue (U.S. Dollars)

Period (Month)	Total
Oct 2006	$11,637.32
Nov 2006	10,594.09
Dec 2006	11,324.57
Jan 2007	11,969.13
Feb 2007	11,328.53
Mar 2007	12,920.88
Apr 2007	12,439.54
May 2007	11,901.93
Jun 2007	11,128.27
Jul 2007	8,923.54
Aug 2007	9,644.97
Sep 2006	9,518.62
Total	**$133,331.39**

Source: Government of Guam, Department of Administration, Division of Public Transportation Services.

3.2.2.5 Guam Mass Transit Vehicles and Facilities

The current fleet of transit vehicles that are compliant with the Americans with Disabilities Act (ADA) and ready for service is divided among the three private operators. While the private operators provide tourist shuttle service as their mainstay, each company owns and maintains its respective section of the public transit fleet—assuring the vehicles meet the requirements for service in the public sphere. Typically, vehicles with less than 30 seats are dedicated to demand-response service or paratransit service. Table 3-14 lists the fleet used for Guam Mass Transit service.

The fixed routes are serviced with Gillig/Phantoms and Bluebirds. However, non-ADA-compliant vehicles are dispatched to fixed routes occasionally because of maintenance challenges. Further, higher capacity vehicles are periodically deployed to demand-response routes for the same reasons. With current levels of service, 17 vehicles are deployed daily between the five fixed routes and six demand-response areas. The remaining 15 vehicles are either deployed in paratransit operations or they are off-network for maintenance.

Currently, capital facilities related to the day-to-day operation of mass transit service are owned separately by the three private operators. Because the companies also supply tourist bus service, operations and maintenance facilities are used for both. The costs of maintaining the public fleet, and the facilities used, are difficult to separate from those associated with the private services because both share the same facilities, mechanics, and parts.

Table 3-14: ADA-Compliant Transit Vehicles on Island and Ready for Service

Operator	Make/Model	Number of Vehicles	Passenger Capacity per Vehicle
Sanko	Gillig/Phantom	4	32
Sanko	Ford/Econo-Line	1	7
Sanko	Ford/Aerotech	1	17
Sanko	El Dorado/MST	1	18
Kloppenburg	Blue Bird	6	36
Kloppenburg	Gillig/Phantom	3	32
Kloppenburg	Ford Cut-Away	5	20
MHI	Gillig/Phantom	6	32
MHI	Ford Cut-Away	3	15
MHI	El Dorado/MST	2	25
Total On-Island ADA-Compatible Transit Vehicles		**32**	

Operations management and dispatching are conducted from the Kloppenburg headquarters. Kloppenburg conducts all operations management activities, including fixed-route, demand-response, paratransit, and road service dispatch, as well as system supervision. Kloppenburg also conducts paratransit scheduling, pass sales, and low level customer service. Revenue operations are divided among the private operators because each operator's vehicles return to that company's yard at the end of each service day.

A section of the Chamorro Village, located in Hagatna, currently acts as a transit center consisting of a shared-use parking lot with two bus shelters. Only one route in the fixed system is not anchored by this location. In addition to the fixed routes, all demand-response routes originate and terminate at the Chamorro Village. In this respect, the current network acts as a low frequency "pulse" system—having the majority of routes service one central location simultaneously so as to maximize transfer potential. The Government of Guam Department of Administration Transit Operations Planning Office is located adjacent to the transit center in the Chamorro Village.

Fixed-route layover points occur both on street and in private parking lots. Table 3-15 lists terminus points for fixed routes in the existing mass transit system.

Table 3-15: Fixed-Route Terminal Points

Route	Terminus 1	Terminus 2
Blue Line 1	Chamorro Village	Fatima Street
Blue Line 2	Chamorro Village	Agat Mayor's Office
Express	Chamorro Village	Fatima Street
Red Line 1	Chamorro Village	N/A*
Green Line 1	Chamorro Village	Yona Mayor's Office**
Grey Line 4***	Fatima Street	Yigo Mayor's Office

*The Red Line 1 is a loop route having only one terminus
**The Green Line 1 switches from fixed-route to demand-response at this point and continues south
***The Grey Line 4 only operates on Sundays and Holidays

3.2.2.6 Assessment of Existing Guam Mass Transit

Scheduled and Actual Running Times

Fixed-route transit scheduling on Guam presents a major opportunity for short-term service improvement. The time allowed in the public timetable for transit vehicles to accomplish their route is sometimes unrealistic and generally excessive. Further, time given to routes for correction of variations in running time because of traffic congestion and passenger-related delay (recovery time) is not allocated properly.

Knowledge of the actual time required for transit vehicles to travel through their route is critical to maintaining an accurate public timetable. If vehicles are given too little time, they will arrive late at stops. If vehicles are given too much time, they will arrive (and depart) early from stops along the route. While both cases are undesirable, the latter has greater impact to the riding public. Because this scenario leaves the passenger arriving at a stop at the scheduled departure time with no possibility of catching the vehicle, many transit providers strongly discourage this practice.

Recovery time assigned to fixed routes lets the vehicle pause at both ends of its route before departing for the next return trip. This down time accomplishes two tasks: first, the time allows the driver a break for food or restroom needs; second, the time allows the vehicle to fit properly into the next return trip outlined in the printed timetable, even if it arrives late. The second task accomplished by recovery—allowing for a proper insertion into the timetable—has a statistical implication. While the transit vehicle faces average travel time through its route, the reality is that this time is subject to natural variation. Recovery time is then critical to account for this variation in real-life travel times. Because this time is non-productive, the theme for applying recovery time is “not too much, not too little.”

As a rule-of-thumb, recovery time should be approximately 10 percent of time spent in travel. The average scheduled recovery time for Guam Mass Transit is currently 25 percent. While this average recovery time is not extreme, the way in which it is distributed is not balanced. The minimum scheduled recovery time is 0 percent and the maximum scheduled recovery time is 74 percent.

Table 3-16 provides scheduled and observed fixed-route times for three of the four weekday fixed-routes operated on behalf of Guam Mass Transit and scheduled times for the fourth such route. Route Green Line 1 provides partly fixed and partly demand-response service and is not included in Table 3-16.

The data in the above table shows that actual (observed) running times in every case are much shorter than the scheduled times. This results in inevitable running early (“running hot”) and highly excessive recovery times. The effects are that printed timetables are not useful to passengers, and service productivity is much less than it might be if realistic running times and normal allowances for recovery time were applied. The current run plus recovery times are designed to keep cycle times at uniform one-hour or two-hour intervals. Re-design of the service could lengthen routes to make better use of the overall cycle time, keeping to the one-hour and two-hour modules, or alternatively could provide

more frequent service on each route. Either approach can be expected to be significantly more productive—i.e., greater ridership with no increase in operating cost unless hourly compensation rates are increased to account for additional miles operated.

Table 3-16: Scheduled and Observed Fixed-Route Running Times

Route	Observation	First Run	Recovery 1	Run 2	Recovery 2	Cycle Time	Percent Recovery
Blue Line 1	Scheduled	58	2	57	3	120	4%
	Actual	*32*	*28*	*30*	*30*	*120*	*94%*
Blue Line 2	Scheduled	37	23	32	28	120	74%
	Actual	*29*	*31*	*24*	*26*	*120*	*126%*
Express	Scheduled	30	0	30	0	60	0%
	Actual	*21*	*9*	*18*	*12*	*60*	*54%*
Red Line 1	Scheduled	50	10	59	1	60	2 to 20%
	Actual	Not Sampled					

Source: Scheduled data from Government of Guam, Department of Administration, Division of Public Transportation Services; actual data as observed on a single-sample basis by Parsons Brinckerhoff (January 2008).
Note that run times are in one direction. With the exception of Red Line 1 (a loop route), cycle times are double the run plus recovery time, to allow for the return journey of each round trip.

Comparisons against Peer USA Transit Systems

Initial review of Guam Mass Transit data strongly suggested that service deficiencies result in substantially lower transit use than could be expected. Consequently, a comparison with peer transit systems was undertaken. The best known data source for this purpose is the FTA's National Transit Database (NTD), which is collected from U.S. transit systems annually. Using the 2005 NTD, a sample of transit systems was selected to encompass a range of geographic area served and population served that would be broadly similar to the statistics for Guam. The selected sample contains data for 22 systems, reporting geographic areas ranging from 65 square miles to almost 800 square miles and populations served from 100,000 to 200,000. Table 3-17 provides the NTD data of interest for these systems, which are widely distributed within the U.S.

In some respects, the NTD data are limited because those who prepare data for their transit system may not all have the same understanding of data definitions. This may be especially true of data items such as geographic area served and population served. In addition, there are no known U.S. systems directly comparable to Guam in their physical or demographic characteristics.

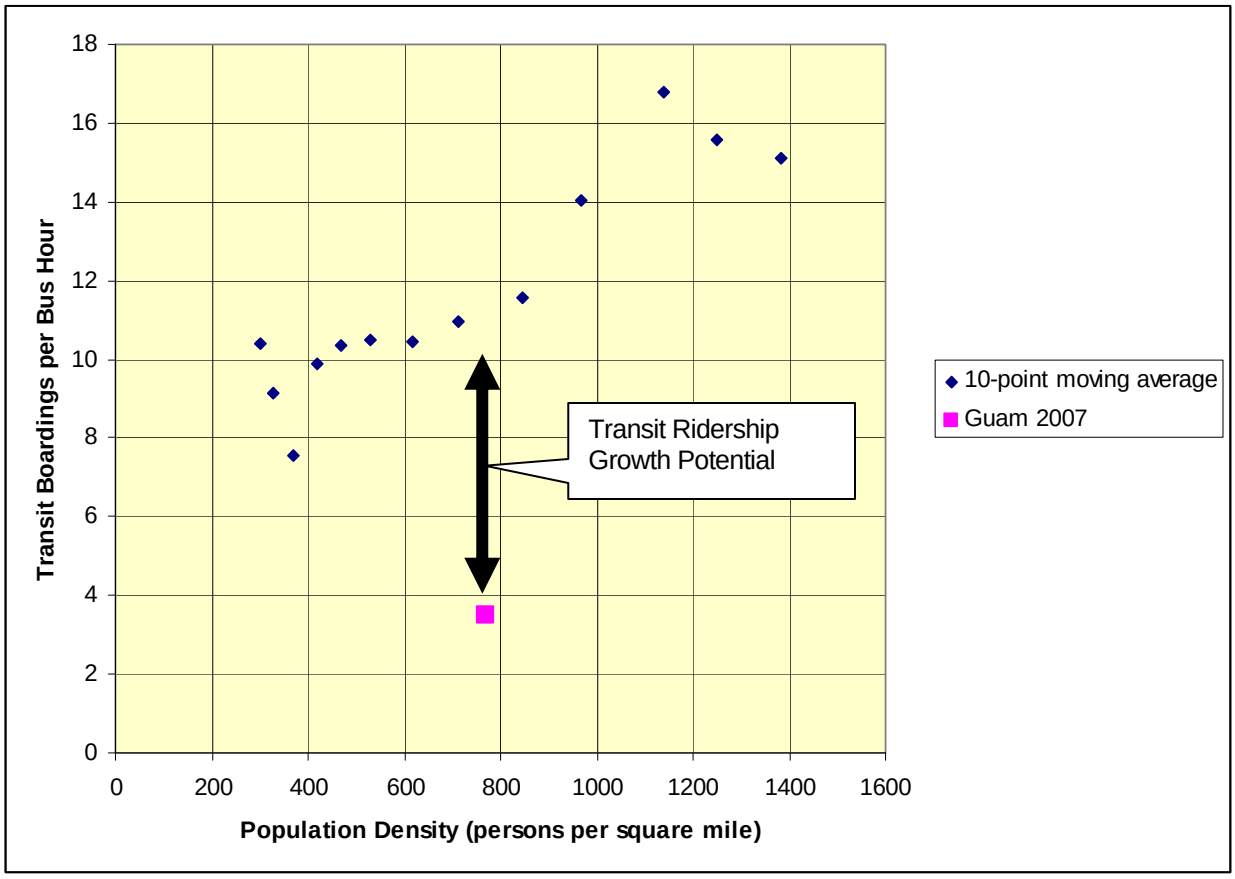
This study first assessed whether Guam Mass Transit system productivity is unusually low compared to other similar cities or transit providers. This was done by sorting the NTD sample on the basis of population density (persons per square mile) and comparing the density range with transit boardings per revenue service hour. In Figure 3-20, it is evident that productivity, measured in this way, is on the order of one-third the level achieved by the systems of similar population density in the sample. In other words, it might be possible, with service improvements, to carry existing ridership with only one-third the present amount of transit service. An alternate view of this finding is that better use of the

current expenditure level might result in as much as a three-fold increase in transit ridership.

Table 3-17: Selected Transit System Data (2005 National Transit Database)

City	State	Population Served	Area Served (square miles)	Annual Vehicle Revenue Hours	Annual Passenger Boardings
Bellingham	WA	177,130	776	148,465	3,382,349
Pittsfield	MA	127,500	384	43,383	508,776
Danbury	CT	154,855	124	83,824	773,037
Fitchburg	MA	193,415	338	208,577	617,134
Vestal	NY	165,000	712	155,789	2,828,981
Bridgeton	NJ	146,438	489	53,352	147,842
Chattanooga	TN	155,554	289	158,886	2,036,009
Jackson	MS	196,000	114	83,236	761,766
Lakeland	FL	110,000	77	119,243	1,538,232
Tallahassee	FL	162,310	102	168,308	4,612,725
Kent	OH	152,061	492	111,157	1,096,803
Duluth	MN	122,970	143	142,256	2,709,249
Bay City	MI	110,000	447	94,737	525,916
Rochester	MN	104,230	147	72,060	1,300,793
Valparaiso	IN	130,000	400	27,876	111,019
Port Huron	MI	164,235	700	125,279	451,794
North Little Rock	AR	164,912	98	188,610	2,127,711
Grand Prairie	TX	134,450	80	10,998	34,026
Denton	TX	102,000	65	57,544	1,265,309
Waterloo	IA	109,418	89	60,255	340,181
Redding	CA	114,462	100	73,748	762,404
Peoria	AZ	140,000	175	7,501	34,428

Figure 3-20: Population Density and Transit Productivity

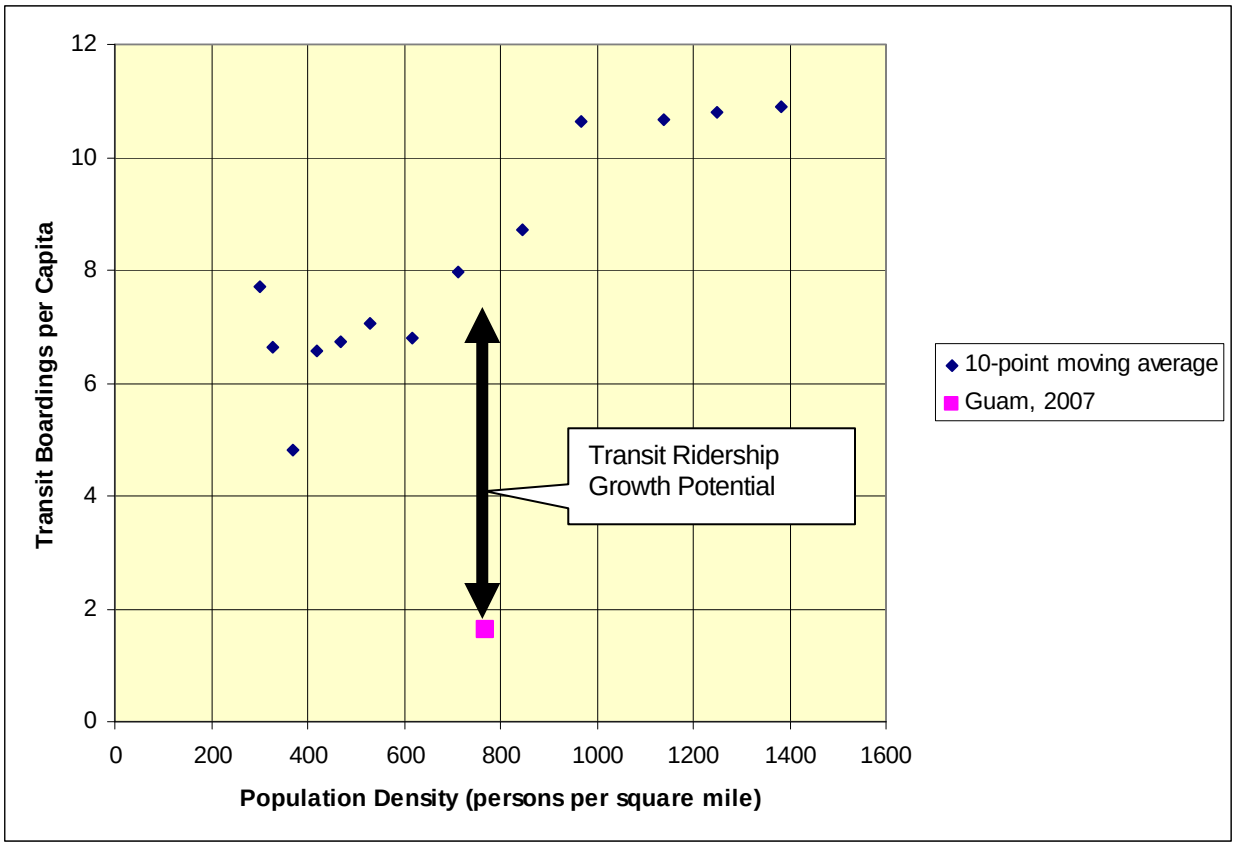


Source: Parsons Brinckerhoff analysis of selected U.S. transit systems.
Notes: (1) Productivity defined as transit passenger boardings per revenue service hour. (2) Sample selected by Parsons Brinckerhoff on the basis of population served and area served within general range of Guam population and area.

The service deficiencies noted in preceding sections of this report help to explain why system productivity is low. Very long headways, unattainable schedule adherence, and inadequate public information would be contributing factors affecting fixed-route service. Cancelled or "no show" demand-response trips and other evidence of limited management resources reduce the potential productivity of the demand-response service. Paratransit service productivity has an adverse effect on the system because it is probably too large a component of overall system service and is generally operated with inappropriate vehicles for this kind of service.

The next issue investigated was whether the current level of transit use is within an appropriate range, considering the population and area served by Guam Mass Transit. For this purpose, transit passenger boardings per capita were calculated and compared with the NTD data. As in the first analysis, the data were plotted according to population density. Figure 3-21 provides the results.

Figure 3-21: Population Density and Transit Use



Source: Parsons Brinckerhoff analysis of selected U.S. transit systems.
Notes: (1) Productivity defined as transit passenger boardings per capita. (2) Sample selected by Parsons Brinckerhoff on the basis of population served and area served within general range of Guam population and area.

These results are closely comparable to the transit productivity analysis, except for demonstrating that ridership might be as much as four times the current level, provided appropriate service improvements were made.

The two productivity analyses shown in Figure 3-20 and Figure 3-21 demonstrate that an improved and moderately expanded transit system on Guam could achieve a much larger level of transit ridership, more in keeping with average or typical results in the continental U.S. This kind of improvement could be accomplished within a short time period, would make a very significant contribution to personal mobility on Guam, and would set the stage for larger transit system expansion steps. Those steps would respond to the anticipated transportation issues that will result from the increase in population and economic activity with the planned military build-up.

Management and Operation of Service

At present, the Government of Guam lacks resources to provide adequate planning and oversight of the public transportation services. This is evidenced by the inefficient schedules of the fixed routes and by perceptions, on the part of the service operators and the general public, of the absence of active management, information, and marketing efforts. The task of demand-response dispatching, for

example, is not observed and checked. Schedule adherence on fixed routes is not checked, and there is no evidence of verifying that the private operators fulfill purchase orders and perform all the services for which they bill. There is a need for greater resources to be made available in order to improve the planning, management, and operation of Guam Mass Transit.

Marketing Deficiencies

The absence of any active marketing program for public transportation was noted earlier in this report. Marketing is a normal and important part of a transit program. An effective marketing program will be essential to building the success of the transit system when the recommended improvements are implemented to adequately deliver, fund, and equip transit service.

Vehicle Fleet Condition and Replacement Needs

As of March 2008, the Guam Mass Transit bus fleet consisted of 30 active vehicles, compliant with the ADA, and owned and operated by three private companies under direction from the Government of Guam Department of Administrative Services. Table 3-14 provides a list of these vehicles by make and model.

The entire fleet can be broken down into two main categories. The first category includes vehicles best suited for fixed-route transit operations and consists of vehicles with capacity of 20 seats or more. The second category would be suited best for paratransit operations and is made up of vehicles with less than 20 seats.

Table 3-18 illustrates the range of fleet age by operating type. Of the 21 fixed-route-capable vehicles, the youngest vehicle is a six-year-old El Dorado MST and the oldest vehicle is a 23-year-old Gillig Phantom. Of the nine vehicles best suited for paratransit operations, the youngest vehicle is a seven-year-old Ford E354 van and the oldest vehicles are three 12-year-old Ford E350 vans. The number of vehicles by age group is illustrated in Figure 3-22 and Figure 3-23.

Table 3-18: Age of Vehicles Used by Guam Mass Transit

	Fixed-route	Paratransit
Total Vehicles	21*	9
Minimum Age (Years)	6	7
Average Age (Years)	15.6	8.4
Maximum Age (Years)	23	12

*Two Gillig Phantoms are not accounted for in the analysis of vehicle age due to permanent hard-down status.

Figure 3-22: Age of Fixed-Route Transit Vehicles

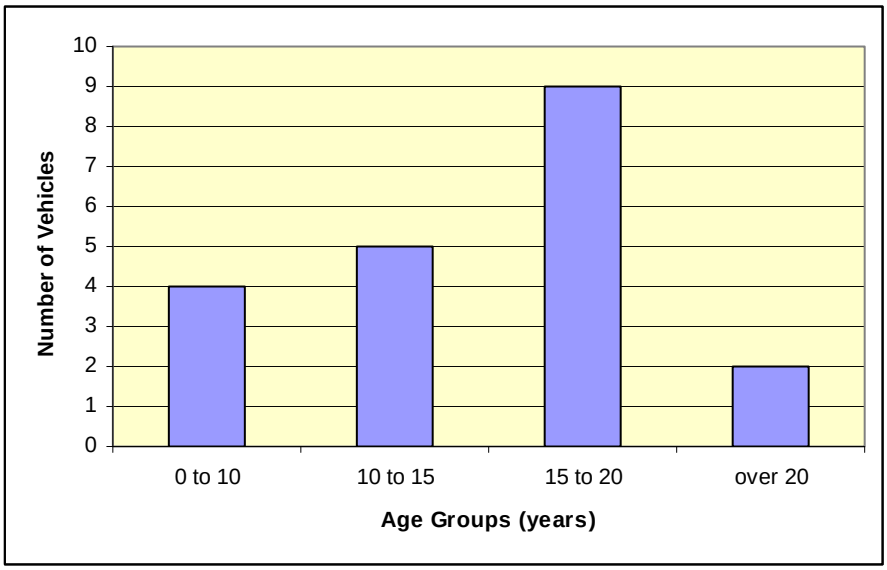
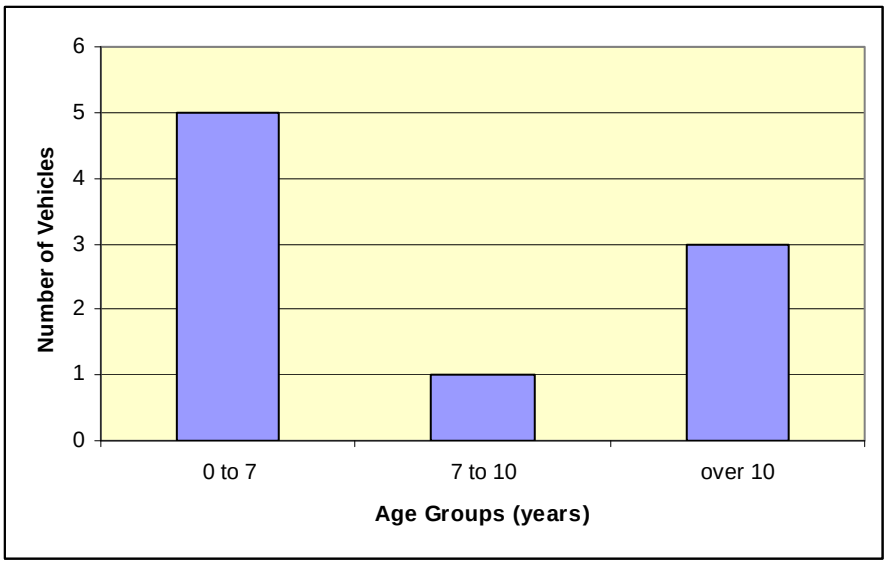


Figure 3-23: Age of Non-Fixed-Route Transit Vehicles



The majority of vehicles operating on fixed routes have been in service elsewhere or on Guam for 15 to 20 years. These vehicles may have traveled one million miles or more at the present time. The expected life-cycle of these buses has expired, and this section of the fleet should be considered for immediate replacement.

Normal transit system practice is to replace larger vehicles once they have been in service 12 years and smaller vehicles usually after 5 to 10 years. Thus, most

of the vehicles in both fleets should be considered for replacement. Unfortunately, there is no residual value in older vehicles due to the absence of demand for them on Guam and prohibitive shipping charges to sell them elsewhere. The smaller vehicles are less expensive and might not require separate shipping charges because dealers can ship this type of vehicle through their internal supply chains. Large capacity vehicles, on the other hand, are not only more expensive but also require a shipping fee and a devanning fee at the port. These fees add substantially to transit vehicle cost.

The fixed-route operating vehicles on Guam have until now been purchased from the secondary market for transit vehicles. This is because of a general shortfall in capital (transit vehicle) replacement and procurement funds and a constraint on fuel supply on the island. Currently, only conventional diesel is imported to the island. Transit vehicles manufactured for operation in the U.S. and Europe, however, are designed to utilize low and ultra-low sulfur diesel fuel (less than 15 parts per million sulfur). Modification or replacement of low-sulfur diesel engines in new vehicles would raise the total investment for vehicle purchase to an economically infeasible level. Consequently, there is a need to develop a source of low-sulfur fuel to support importation of new vehicles for the Guam Mass Transit fleet. An alternative, also with fuel supply issues, would be to procure compressed-natural-gas-fueled vehicles.

These factors, as well as the desirability of building a first-class public transportation system on Guam, argue for early replacement of the entire fleet with new low-emission air-conditioned vehicles.

3.2.3 Bicycle and Pedestrian Systems

Guam's roadways have limited accommodations for pedestrian and bicycle travel and the quantity and quality of facilities varies throughout the island. Sidewalks and roadway shoulders comprise the existing bicycle and pedestrian system. The condition of pedestrian facilities generally mirrors general road conditions and is deteriorated in some areas. Sidewalks often contain obstructions, such as fire hydrants, power poses, traffic signal controllers, or other utilities. The majority of the 26 miles of sidewalk is on the central western portion of the island, in the Hagatna and Tumon Bay area, as described in more detail below.

No marked or designated bicycle lanes or paths exist at this time. Where no sidewalks are present, the shoulder generally functions as a pedestrian space and is used for running and bicycling. However, bicycle and pedestrian mobility and safety on road shoulders can be impeded by conflicting uses, such as parking. The width and condition of roadway shoulders varies throughout the island. Shoulders are present along large segments of Route 1 and on Route 3 from Route 1 to Route 28.

All of the 78 signalized intersections on Guam contain a pedestrian indication on at least one of the intersection legs. Seven of these signalized intersections are specifically dedicated to pedestrian traffic. Crosswalks are also present at the signalized intersections, as well as many non-signalized locations.

3.2.3.1 Walking and Bicycling Travel Characteristics

According to the 2000 Census commuting statistics, 1,483 persons in Guam walked to work and 202 persons biked to work. This encompasses 2.5 percent and less than 1 percent, respectively, of the number of people travelling to work. Guam has an organized running club, The Guam Running Club, which hosts several running races, including a marathon, and training sessions throughout the year. Guam also has a bicycling group, the Guam Cycling Federation, which holds both road and mountain bike races.

3.2.3.2 Locations of Sidewalks

There are sidewalks on both sides of Route 1 (Marine Corps Drive) from the intersection with Route 28 in Dededo, through Tamuning, Mongmong-Toto-Maite, and Agana, to the intersection with Route 6 in Asan. In Agana, there are also sidewalks along Route 4 from Route 1 to the intersection with Route 7 by the McDonald's. Intermittent sidewalks exist along Routes 7 and 7a. Table 3-19 and Table 3-20 list roads with existing and intermittent sidewalks.

Table 3-19: Roads with Existing Sidewalks

Route	Length (miles)
Route 1	9.42
Route 4	0.66
Route 4 low	0.62
Route 7a	1.1
Route 10	3.73
Route 10a	2.09
Route 14	4.36
Route 27	2.52
Route 30	1.72
Total Length	**26.22**

Table 3-20: Roads with Intermittent Sidewalks

Route	Length (miles)
Route 8	3.29
Route 11	2.27
Route 26	0.97
Route 28	1.12
Route 30	0.54
Total Length	**8.19**

As the primary tourist area of Guam, Tumon Bay contains more investment in pedestrian infrastructure than other areas. There are sidewalks along the length of Routes 14 and 14a. There are approximately six mid-block crosswalks along Route 14, half with pedestrian refuge in the raised, planted median. Well-marked,

stamped crosswalks are also present on at least two legs of all major signalized intersections.

As for the remainder of the island, sidewalks are located along Routes 10a, 16, 27, and 27a. On Route 4 in Yona, there is also a small section, approximately 1 mile, which has new sidewalks on both sides at the entrances to a residential development. Intermittent sidewalks exist on Routes 8, 11, 26, 28, and other places in the central region. The northern tip and southern half of the island do not contain any pedestrian or bicycle facilities. In these areas, the shoulders, which are generally unpaved, function as the pedestrian/bicycle space. In fact, no formal bike lanes or paths exist on Guam, and cyclists utilize the outer lane or shoulder in most areas.

Marked crosswalks and pedestrian safety devices are present at signalized intersections. Crosswalks use the standard (two parallel lines) or continental marking pattern. There are also mid-block, signalized crossing locations to accommodate pedestrians at specific churches and schools. Existing bicycle and pedestrian facilities are shown in Figure 3-24.

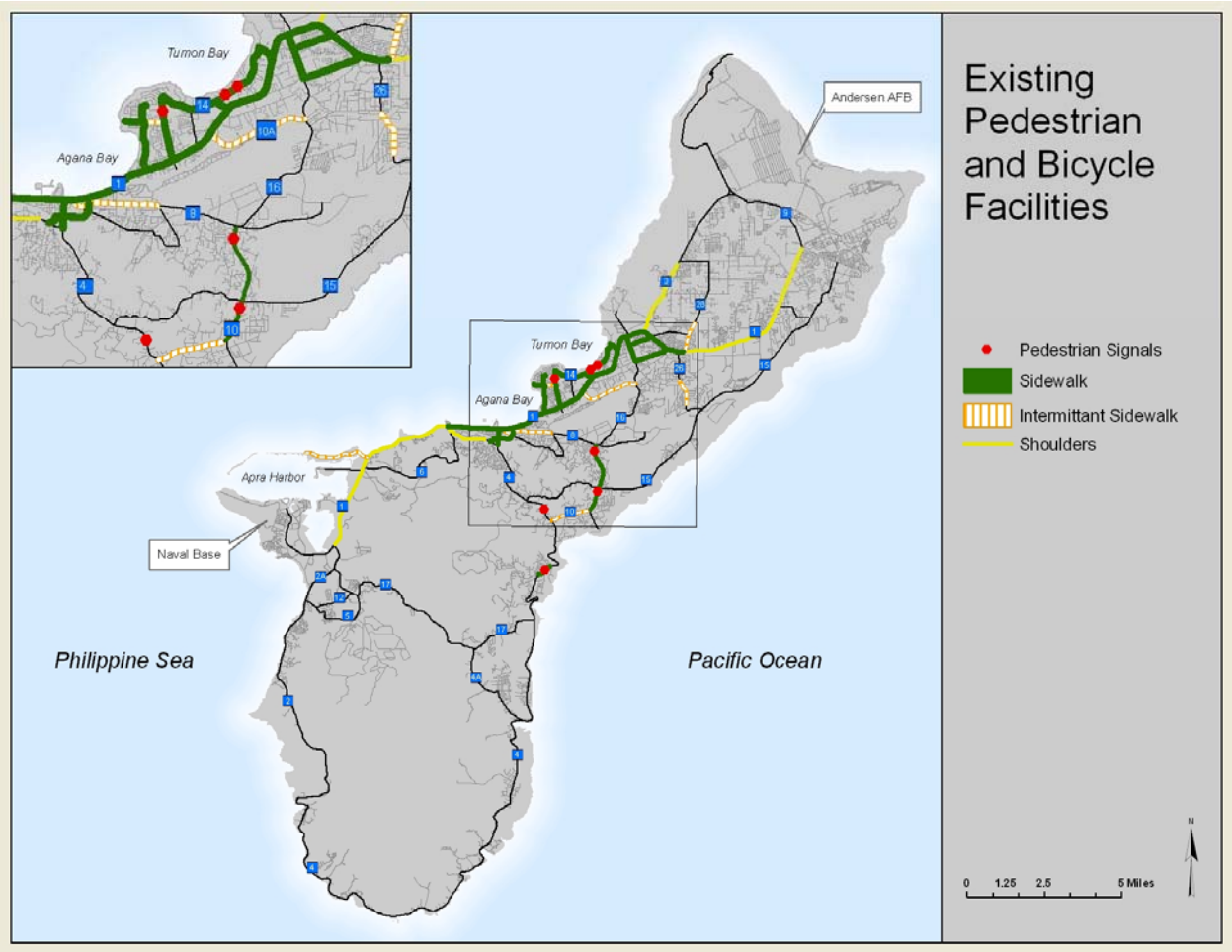
3.2.3.3 Challenges to Walking and Bicycling

Comments received at a public meeting indicate concerns with the current status of the pedestrian and bicycle infrastructure on Guam. Some meeting attendees expressed a desire for increased pedestrian and bicyclist safety through the following:

- Separating bicycling and running lane along Marine Drive to Nimitz Hill
- Providing a pedestrian overpass at all intersections from Tamuning to Yigo, including Agana (Hagatna)
- Improving crosswalks, curb bulb-outs, ADA alterations, and visibility of street makers
- Appropriate signal timing to allow pedestrians more time to cross street
- Adding more signage or advanced notification of crosswalk/pedestrians ahead

Pedestrian/auto accidents are, unfortunately, a common occurrence on Guam. The vast majority of these accidents occur at night in areas where street lighting levels are low and where pedestrian crosswalks do not exist, are not clearly marked, or are spaced too far apart. Cultural differences also contribute to pedestrian-related accident counts as foreign visitors, particularly from Japan, are apt to look the wrong way when crossing the street. Finally, along village streets, there is a lack of sidewalks and, in many instances, minimal shoulder space for pedestrians.

Figure 3-24: Existing Pedestrian and Bicycle Facilities



3.2.4 Waterways

While the surface transportation system allows for travel throughout Guam, waterways and aviation facilities enable the movement of people and goods to and from the island. Apra Harbor, shown in Figure 3-25, is a deep-water port that serves both as a U.S. Navy station and as a commercial port. Located 5 miles west-southwest of Guam's capital, Hagatna, it is formed by Cabras Island, a low-lying reef and finger of land that was extended by the construction of Glass Breakwater in the 1940s, and Orote Peninsula. Apra Harbor is not a sheltered port, but hills to the south and southeast do provide a limited wind break. The 500-yard wide, 100-foot deep entrance to the harbor faces west into the Philippine Sea. Much of the outer harbor is in excess of 100 feet deep, but there are also some clearly marked reef areas, mostly in the eastern portion near the entrance to the inner harbor.

Figure 3-25: View of Apra Harbor

The narrow channel opening to the inner harbor, which houses Naval Base Guam, lies in the southeastern part of the harbor. The commercial port, which offers approximately 2,400 feet of frontage for deepwater docking, is located in the outer harbor. Operated by Port Authority Guam, the commercial port handles approximately 2 million tons of cargo each year. It also is a transshipment port for the western Pacific, including the Marianas Islands. Other facilities offered at Apra Harbor include a naval supply depot, a public works center, and a power plant.

Cargo facilities at Apra Harbor can efficiently move containerized, unitized, break-bulk, and tuna cargo. Containerized cargo-handling facilities were designed by the Navy and opened in 1969. Table 3-21 identifies Apra Harbor cargo statistics. Ownership and operations were transferred to the Government of Guam in the 1970s. These facilities have remained largely unchanged since construction and are out-of-date for modern cargo operations. The development of the *2030 Port of Guam Master Plan* provides direction for modernizing Guam's only commercial port in preparation for the impending military build-up.

Table 3-21: Apra Harbor Cargo

Cargo Type	Annual Cargo (Year)	Estimated Capacity	Peak Demand
Containers	103,000 boxes (2007)	120,000 boxes	190,000 boxes
Break-bulk	155,000 tons (2006)	Close to capacity	316,000 tons during construction
Cement	100,000 tons (2007)	125,000 tons	693,000 tons during construction
Liquid Fuels	Excess capacity		

The Port of Guam is connected to the highway system by Route 11, which connects to Route 1 (Marine Corps Drive) providing vehicular access for cargo movement for 90 percent of all goods on Guam. This inter-modal connection point will be critical for transporting construction materials and equipment for the planned military construction

activity between 2009 and 2014. It is anticipated that container/chassis movements along Route 1 and other major connector routes will nearly double when the military build-up begins.

The GTP provides and overview of existing port conditions and incorporates intermodal connectivity into surface transportation recommendations. The Port Authority of Guam oversees development of the 2030 Port of Guam Master Plan, which addresses specific needs of commercial port facilities and associated infrastructure requirements.

3.2.5 Aviation

Guam's airport facilities date back to the island's importance during the latter stages of World War II. Agana Naval Air Station was initially constructed by the Japanese in 1944 but was used by the U.S. Marine fighter planes in 1945. The Army Air Forces constructed three more airstrips to stage bombing runs over Japanese targets. These three were North Field, Northwest Field, and Harmon Field. Orote Field was constructed by the U.S. Marine Corps in the 1920s but was infrequently used. While four of the five air strips endure today, only Agana Fields, now Antonio B. Won Pat International Airport, and North Field, now the primary flight line for Andersen Air Force Base, remain in active service. The cross-runway at Orote Field is used for C-130 touch-and-go flight training and for helio-ops by Navy Seals. Harmon Field is now an industrial park.

Guam's commercial airport, Antonio B. Won Pat International Airport, lies in the heart of Guam's business district and is connected to the roadway system by Route 10a. It serves seven international carriers operating passenger routes to destinations throughout the world via connections in Asia, Australia, and Hawaii. Two commuter airlines serve passengers within the Marinas Islands and Federated States of Micronesia. Flight activity from September 2007 through May 2008 totaled 13,242 plane movements, an average of 48 per day. Of these movements, 48 percent were propeller aircraft, 27 percent were wide-body aircraft, and 24 percent were standard jets.

Six cargo and freight forwarding carriers also operate from the airport carrying cargo to and from Guam. In addition to these freight carriers, cargo is also carried on passenger flights. Historically, 60 to 85 percent of cargo space on passenger flights to Japan has been used to transport fresh tuna brought into the Port of Guam by commercial fishing companies.

The airport has two runways—6L/24R and 6R/24L. Efforts are underway to extend and rehabilitate the 6L/24R runway to prepare it for trans-Pacific flights and to begin the second phase of construction on the parallel taxiway. The current physical characteristics of the runways are detailed in Table 3-22 below.

Table 3-22: International Airport Runway Details

Characteristic	Runway 6L/24R	Runway 6R/24L
Dimensions	10,015 x 150 feet	10,014 x 150 feet
Surface	Asphalt/concrete/grooved In good condition	Asphalt/concrete/grooved In good condition
Weight-bearing capacity	Single wheel: 135.0 Double wheel: 235.0 Double tandem: 390.0 Dual double tandem: 780.0	Single wheel: 135.0 Double wheel: 235.0 Double tandem: 390.0 Dual double tandem: 780.0
Elevation	238.9 to 296.9 feet	231.0 to 293.0 feet
Gradient	0.6 percent	0.5 percent
Edge lights	High intensity	Medium intensity

The second aviation facility is located at Andersen Air Force Base (AAFB) on the northern tip of Guam. AAFB was a strategic facility in the Pacific theater during World War II and the Korean and Vietnam conflicts. Today it is home to fighters, bombers, tankers, and global hawks. The unencumbered air space with infrequent competing air traffic and first-rate facilities allows AAFB to serve as an augmented emergency landing site for the space shuttle and as an alternate landing site for commercial airlines during contingencies. Access to AAFB is located at the intersection of Route 1 and Route 9 in Yigo.

Like Antonio B. Wan Pat International Airport, AAFB has two runways—also 6L/24R and 6R/24L by naming convention. The physical characteristics of these runways are detailed in Table 3-23 below.

Table 3-23: Andersen Air Force Base Runway Details

Characteristic	Runway 6L/24R	Runway 6R/24L
Dimensions	10,558 x 200 feet	11,185 x 200 feet
Surface	Asphalt/concrete	Asphalt/concrete
Elevation	540.0 feet	558.0 feet
Gradient	1.4 percent	0.7 percent
Take-off distance	11,607 feet	12,202 feet
Landing distance	10,558 feet	11,185 feet
Edge lights	High intensity Precision approach path indicator	High intensity Precision approach path indicator
Instrument landing system	No	Yes

The high amount of activity at these sites will continue to impact Guam's roadways. Increased tourism, military construction, and an increase in Air Force, Navy, and Marine personnel make the linkages to these aviation facilities an important consideration in the overall transportation plan.

The GTP provides and overview of existing aviation conditions and incorporates intermodal connectivity into surface transportation recommendations. Specific infrastructure needs and recommended improvements for Antonio B. Won Pat International Airport are addressed through the Project Airport Guam program.

3.3 Transportation Programs—Safety and Security

The Department of Public Works—Office of Highway Safety (OHS) is the focal point of highway safety issues in Guam. OHS prepares and administers a comprehensive annual Highway Safety Plan for the purpose of reducing the incidence and severity of crashes on Guam's highway and local street systems. Components of the Highway Safety Plan include the following.

3.3.1 Traffic Record Information Management System

Appropriate and necessary traffic information and data has not been available due to the lack of personnel and proper equipment. Traffic management and planning has been relegated to sporadic information collected by various governmental agencies, such as the Guam Police Department (GPD) with no real focus, purpose, or central data repository. Existing traffic management systems have suffered from a lack of funding, trained personnel, and equipment. Traffic record information and data is crucial to the development and implementation of any transportation plan. A comprehensive overhaul of the existing traffic management information system is needed to include up-to-date computerized systems and equipment, as well as training programs among government agencies that collect traffic data.

3.3.2 Occupant Protection and Passenger Safety

OHS continues to develop and implement public information and education campaigns focused on passenger safety. This includes seatbelt awareness programs, such as "Click It or Ticket" campaigns, in conjunction with the GPD as well as other selective traffic enforcement programs related to speed, impudent driving, and driving under the influence. A summary of vehicle crash statistics on Guam is provided in Table 3-24.

Table 3-24: Crash Statistics 2001-2007

	2001	2002	2003	2004	2005	2006	2007
Total Traffic Crashes	**6729**	**6615**	**6760**	**6561**	**6587**	**6250**	
Number of Fatalities	**19**	**10**	**25**	**15**	**24**	**13**	**16**
Auto-auto	5	1	8	3	4	2	2
Single auto	8	4	6	4	7	4	6
Motorcycle	1	0	3	3	0	0	2
Auto-pedestrian	2	4	3	5	10	2	6
Auto-bicycle	0	0	1	0	0	1	0
Other	3	1	4	0	3	4	0

Source: Guam Police Department

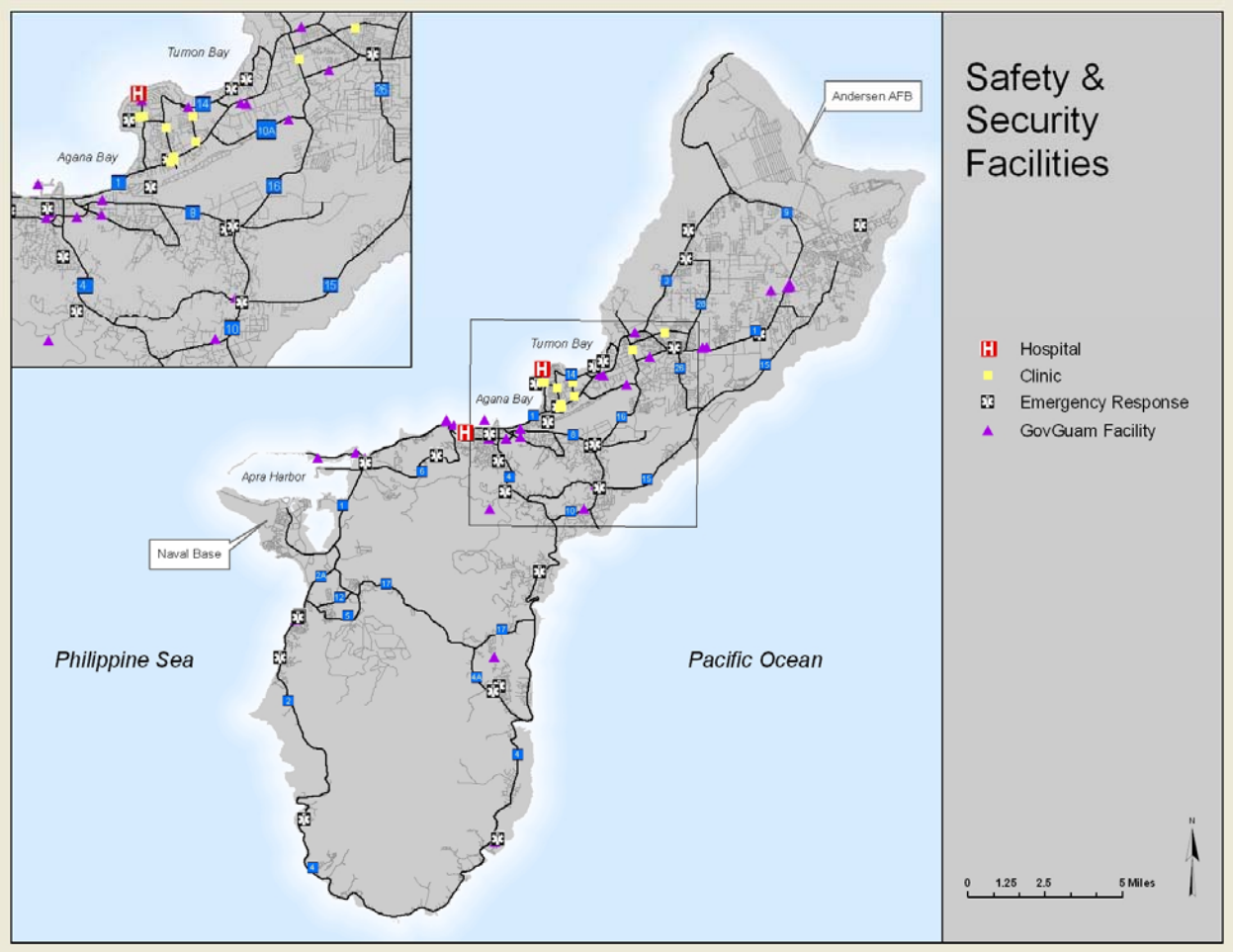
Study after study nationwide has proven that the most effective tool in combating speeding/impudent driving violations and related crashes is to provide routine and consistent patrol of the roadways. To date in 2008, the GPD has issued over 1,600 traffic citations almost entirely for speeding violations. GPD officers work diligently to provide high visibility enforcement coupled with public service announcements.

In previous years, OHS coordinated almost $12.7 million in safety improvement funds provided by the FHWA for the major reconstruction of primary highways and those

roadway segments designated as "defense arteries" by the USDOD. With a current annual apportionment of $536,753 from the U.S. Department of Transportation (USDOT) through the National Highway Traffic Safety Administration, recent emphasis has been placed on safety education and enforcement programs.

The Guam Homeland Security Office of Civil Defense is responsible for managing mitigation, preparedness, and recovery in emergency situations. It maintains the Guam Emergency Response Plan and coordinates the response to all natural and human-caused disasters. In critical situations, the transportation system enables the quick response of emergency services, safe evacuation of civilians, and rapid deployment of the military (Figure 3-26). Additionally, the Department of Administration—Division of Public Transportation Services has developed a System Security and Emergency Preparedness Program Plan to address security and emergency preparedness in all aspects of Guam's transit services.

Figure 3-26: Guam Safety and Security Facilities



3.4 Summary

This chapter has presented a general overview of findings and data that has been collected to assess Guam's existing traffic issues and transportation systems. Guam has experienced recent population, employment, and tourism growth which has resulted in increasing traffic congestion throughout the island. In addition, significant maintenance, rehabilitation, and traffic-signal-operations needs exist on many roadways. Mass transit service provides additional mobility for residents, but transit ridership is limited by unpredictable schedules and a lack of vehicles. Sidewalk facilities are present along some urban corridors, but no designated bicycle facilities are available. Guam is also served by the Apra Harbor deep-water port and the Antonio B. Won Pat International Airport.

This information, in coordination with future demographic and land use conditions, establishes the existing conditions from which Guam's future transportation forecasts, plans, and recommended transportation improvement projects are developed. The analysis of future conditions is discussed in Chapter 4.

4.0 FUTURE DEMOGRAPHIC AND TRAFFIC CONDITIONS

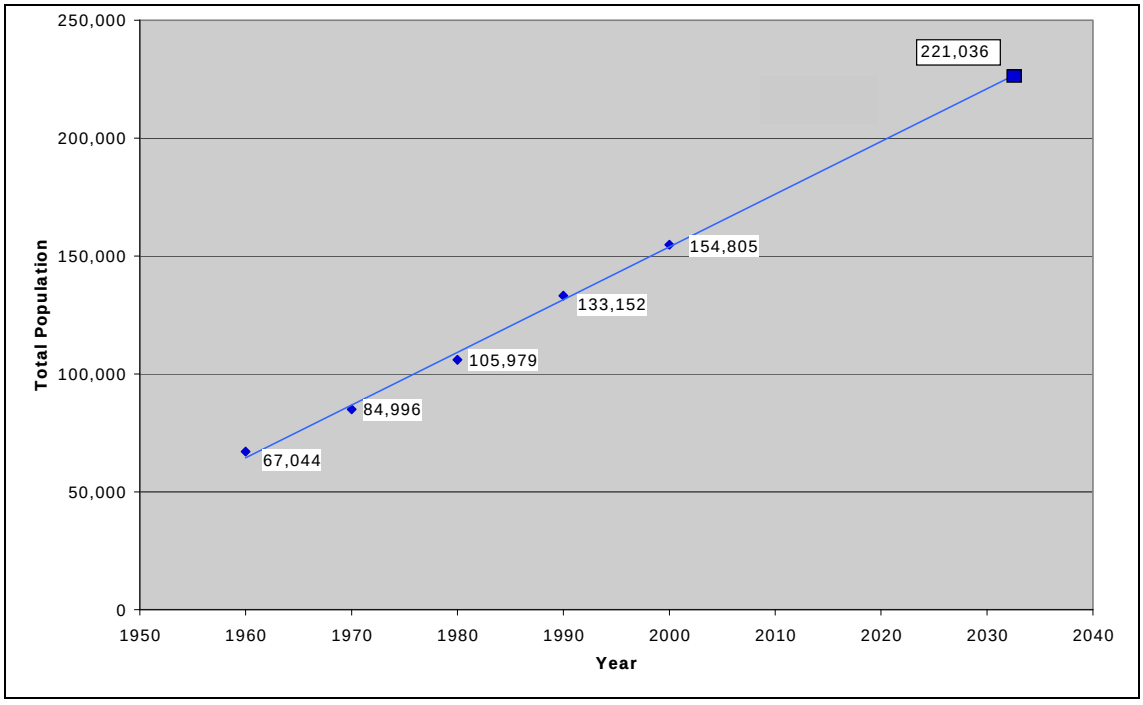
This section describes the anticipated future population, employment, and transportation conditions on Guam through the year 2030. This analysis includes projections for growth based on historic trends in Guam as well as assessments incorporating anticipated military build-up and construction.

4.1 Future Population and Employment Projections

4.1.1 Future Population

Historically, Guam's population has grown at a rate of 1.5 percent annually. If past conditions were to remain constant and growth to continue at the historic levels, Guam's population is projected to reach just over 221,000 residents by 2030. The projected growth trend is shown in Figure 4-1.

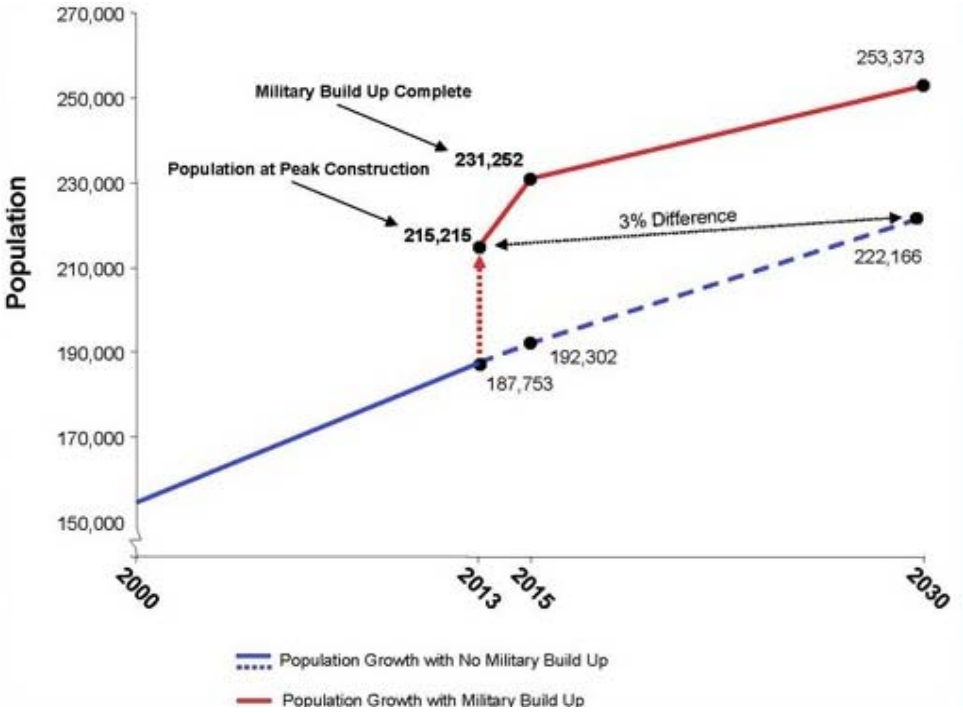
Figure 4-1: Projected Population Growth without Military Build-up (2030)



However, with the proposed USDOD expansion on Guam, historic trends can not be used as the basis for future forecasting. The military build-up will result in a population boom which will be driven by the need to construct large-scale military facilities over a four-year period. This expansion will require a non-resident labor force of approximately 16,000 temporary construction workers. Because of this, new forecasts for future population and employment have been developed using information provided by the

Joint Guam Program Office and the U.S. Air Force. Figure 4-2 compares the projected population growth scenarios both with and without military build-up.

Figure 4-2: Population Growth Scenarios



The resulting impact is that by 2013 (year of peak construction), Guam will have more than 215,000 residents. This is a 22-percent increase over the 2008 population. More dramatically, it means Guam will experience nearly 20 years of its typical growth in only 5 years.

Once the 2013 peak construction period is over, the majority of non-resident construction workers are expected to leave Guam. However, population on the island is not projected to decline after 2013 but instead to increase again with the influx of military personnel, their dependents, and non-resident workers that will be needed to fill indirect jobs. This new population includes approximately 8,600 new active duty personnel (Marines and U.S. Army) and their 9,900 dependents. If no military build-up occurs, the population of Guam is projected to reach approximately 222,000 by 2030, a 26-percent increase over 2008. With the military build-up, the population would reach 253,000 by 2030, a 44-percent increase over 2008. Population projections through 2030 are provided in Table 4-1

Table 4-1: Population Increase (2008–2030)

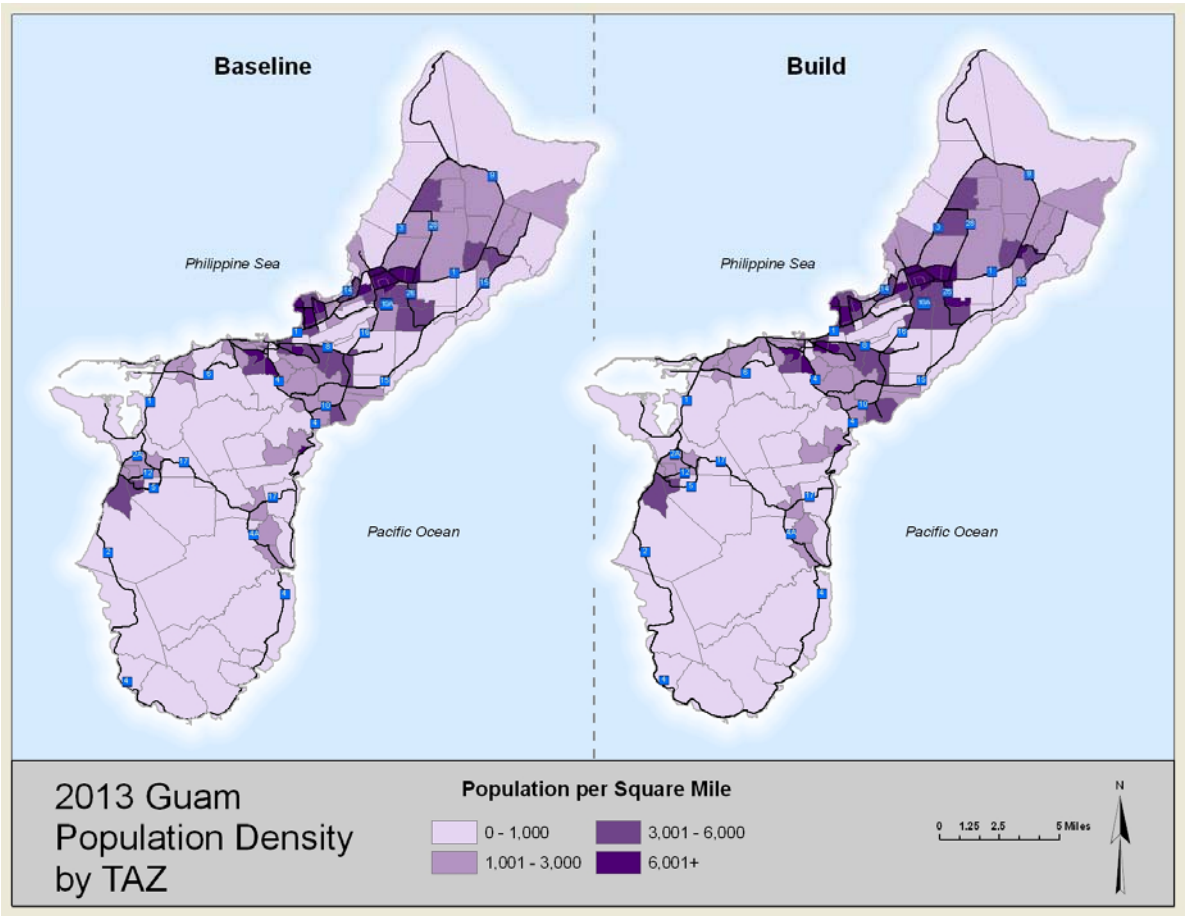
Current 2008 Population	Without Military Build-up		With Military Build-up	
	2030 Population	% Increase (2008–2030)	2030 Population	% Increase (2008–2030)
176,000	222,000	26%	253,000	44%

Source: PB 2008

4.1.2 Location of Future Population

Where people live on Guam in future years will have a tremendous impact on the transportation system. The villages in the northern part of the island (Dededo and Yigo) and the central villages, such as Barrigada, are expected to continue to attract new residential development. Military personnel will, for the most part, be housed on military bases: NCTS Finegayan (Dededo) for the Marines, Navy Base Guam (Santa Rita) for the Navy, and Andersen Air Force Base (Yigo) for Air Force personnel. Residential growth in the southern portion of Guam is expected to be lower due to rugged terrain and wetland areas that cannot be developed. Projected population density in 2013 is shown in Figure 4-3.

Figure 4-3: Population Density by Traffic Analysis Zone (2013)



The military build-up on Guam will include the construction of new housing for the additional military population. In one planning alternative, all of the housing would be located on-base at NCTS Finegayan and South Finegayan. The military build-up will require 3,520 family housing units with 2,640 (75 percent) units at NCTS Finegayan and 880 (25 percent) units at South Finegayan. The remainder of the housing will be bachelor enlisted quarters (BEQ) at NCTS Finegayan. BEQ housing will accommodate the remaining 5,100 personnel. Another possible planning alternative includes a

distribution of family housing among Anderson South, Barrigada-Navy, and Barrigada-Air Force. Population by village in 2030 is shown in Figure 4-4 and the location of construction jobs is shown in.Figure 4-5

Figure 4-4: Projected Population by Village (2030)

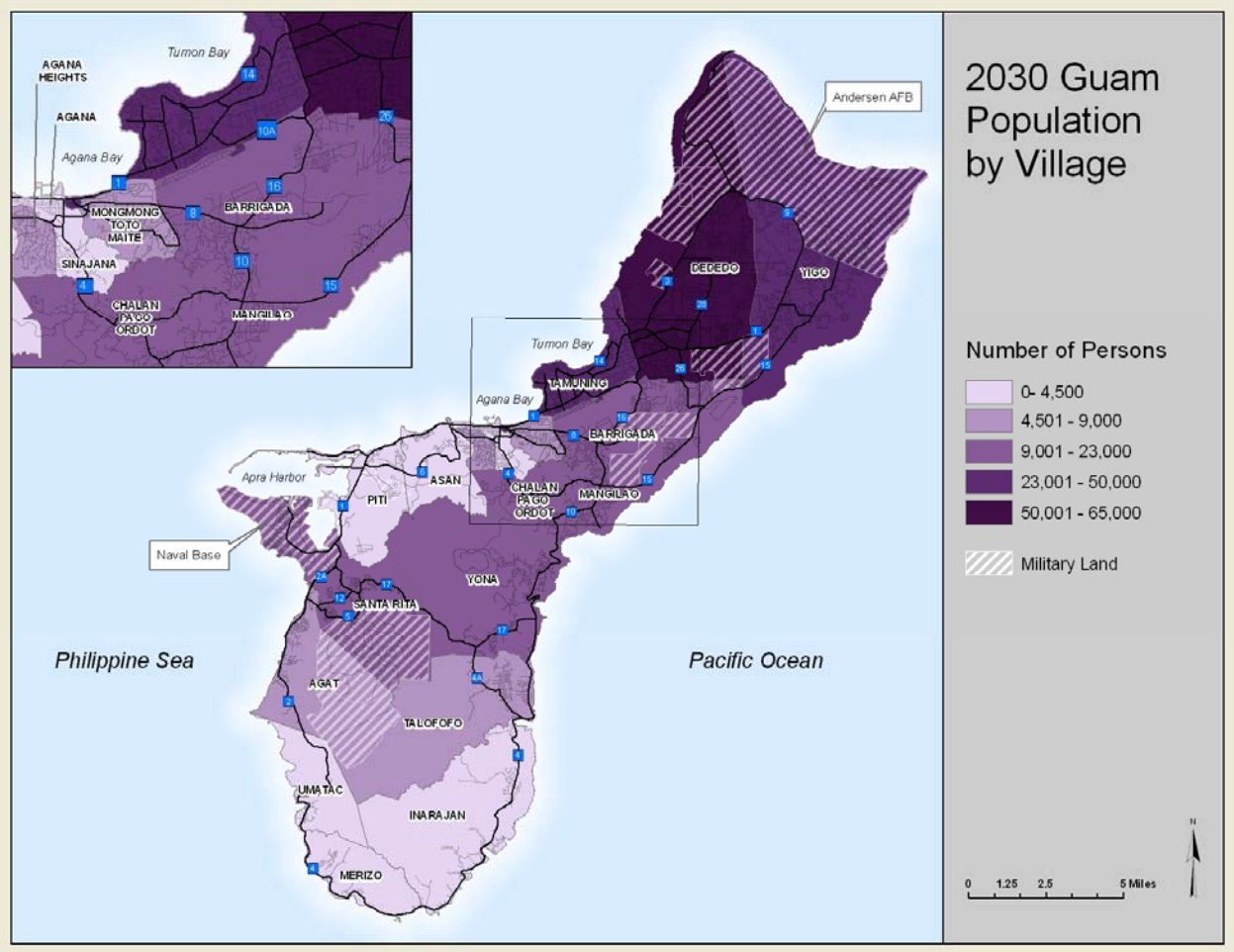
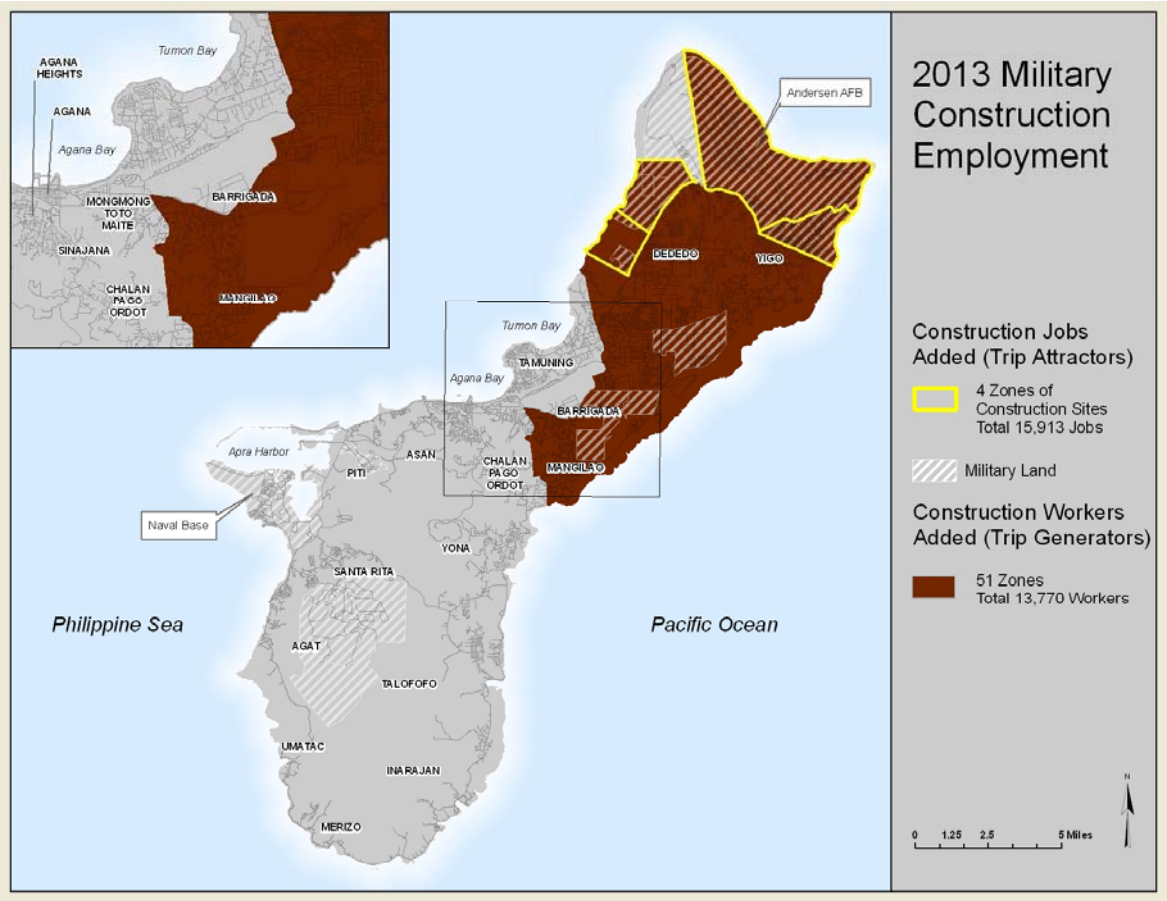


Figure 4-5: Location of Construction Jobs (2013)



4.1.3 Future Employment

The economic forecast for Guam is strong largely due to the increased military presence. An increase in military personnel (with dependents) and tourists means more jobs across all sectors of the economy. Unemployment is forecasted to be near 4 percent in 2013, which is significantly lower than the current unemployment rate of 11 percent.

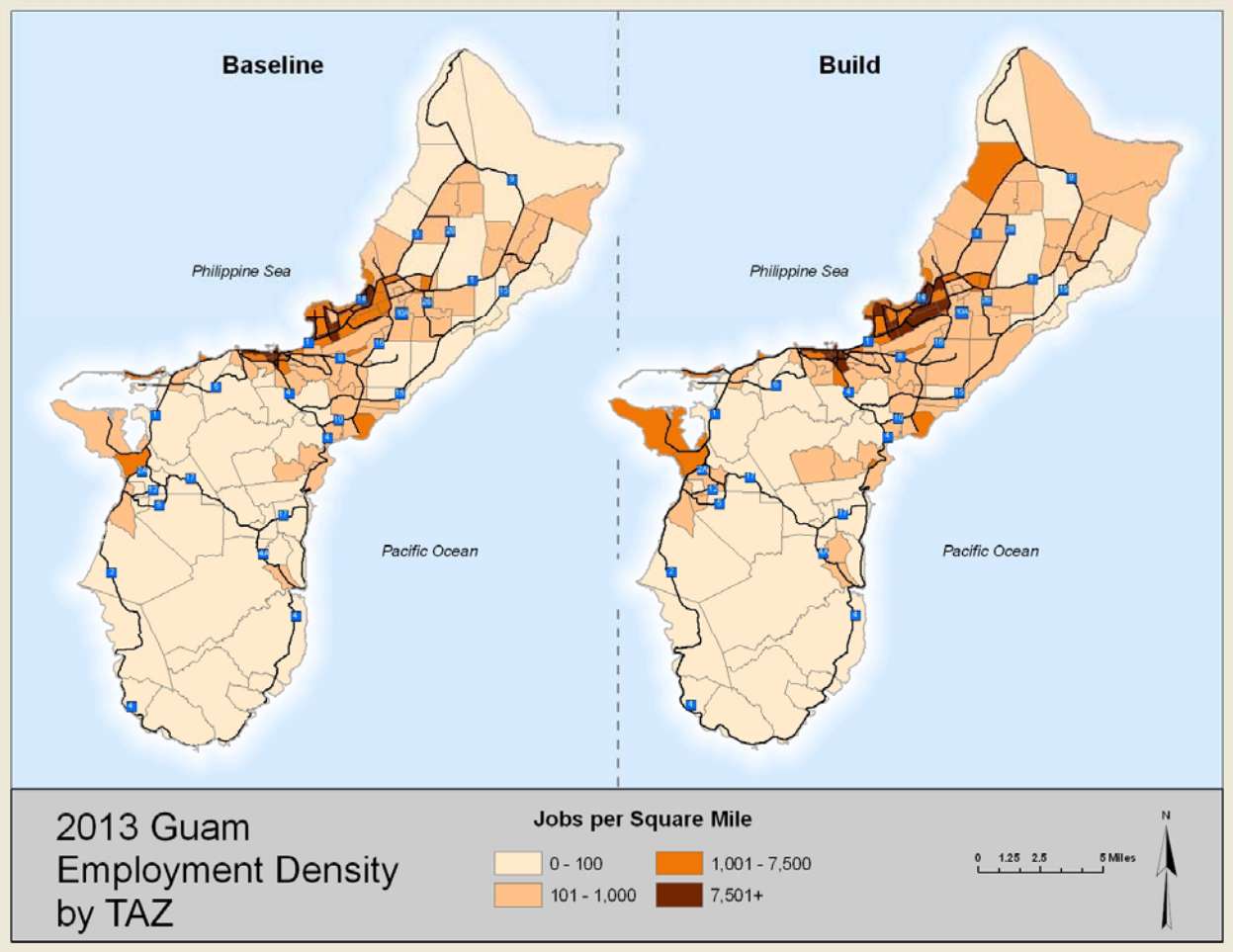
The military build-up will result in many indirect jobs among supporting industries. Between 50 to 78 percent of these positions are likely to be filled by employees from off Guam.

The military build-up will create a boost in construction spending, which will translate into numerous direct new civilian construction jobs as shown in Table 4-2. The USDOD is projecting that between FY2007 and FY2015, construction spending for military projects will total approximately $12.5 billion, with more than $10 billion related to the Marine relocation and the other $2.0 billion for Andersen Air Force Base. The plan is to begin construction in 2010 with a goal for completing construction by 2014. Thus, the number of direct new civilian construction jobs, most likely filled by employees from off Guam, will peak in 2013 and 2014. The lasting employment effect of the military build-up will be over 14,000 new indirect jobs on Guam to support the increased military and construction worker population. The location of jobs in 2013 is shown in Figure 4-6.

Table 4-2: Jobs Projected during Peak Construction (2013) and Military Build-up (2015)

Year	Total Construction Jobs Expected	Total Indirect Jobs Expected	USDOD Civilian Jobs Filled by Guam Residents	Total Jobs
2013	15,913	20,095	250	336,258
2015	6,240	14,354	2,500	223,094

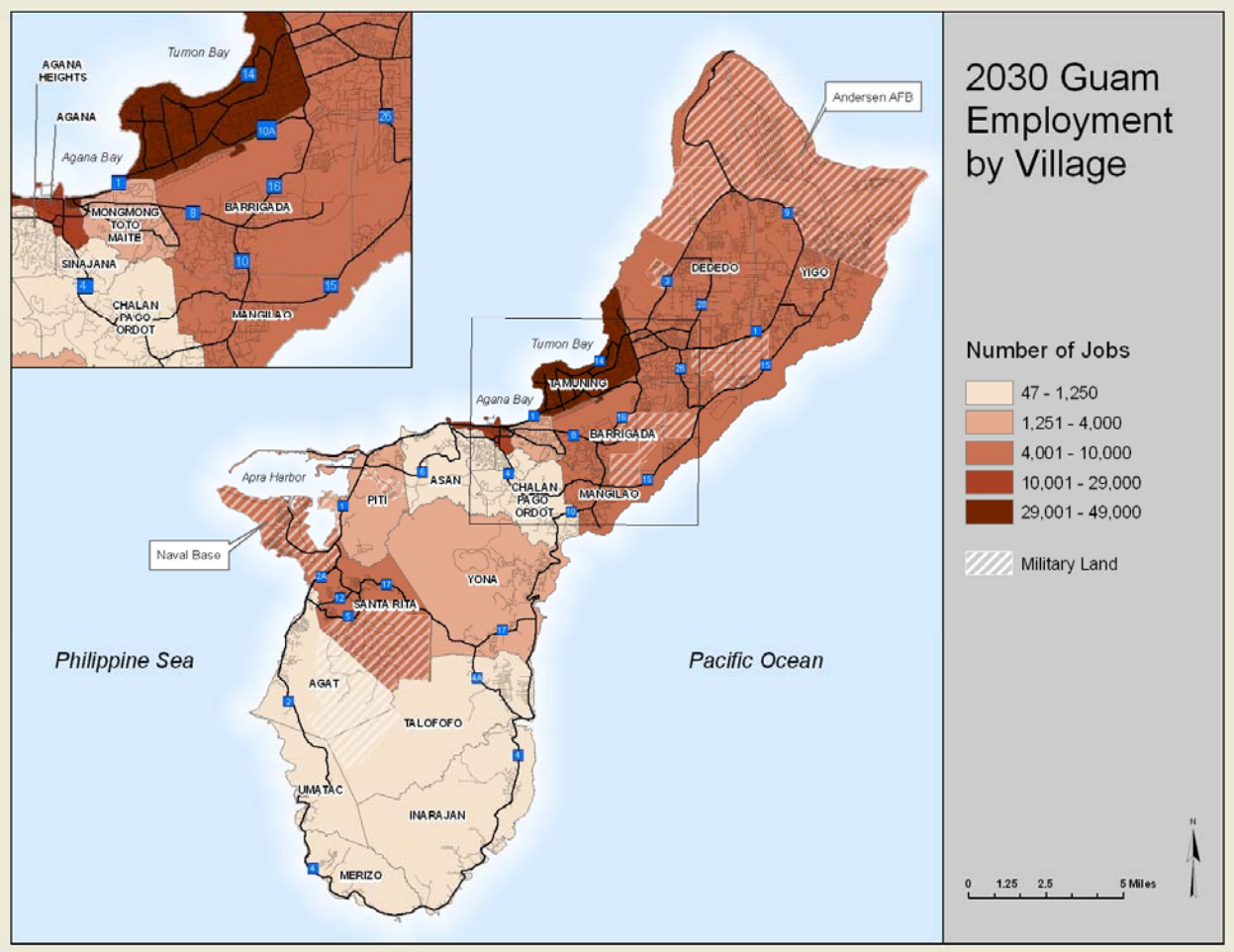
Figure 4-6: Employment Density by Traffic Analysis Zone (2013)



The majority of military-related construction jobs during 2010–2014 will be located at NCTS Finegayan in Dededo, with additional construction taking place at Andersen Air Force Base and Apra Harbor. It is anticipated that concurrent private sector commercial/retail/residential development in support of the build-up will create additional jobs and that these jobs will be located near the proposed military build-up sites (NCTS Finegayan, Andersen, and Navy Base Guam).

In 2030 civilian jobs will continue to be concentrated in the central part of the island, and military jobs will be located on the associated military bases. Employment by village in 2030 is shown in Figure 4-7.

Figure 4-7: Projected Employment by Village (2030)



4.2 Future Transportation Conditions

This section describes the travel demand and traffic congestion conditions that are expected to occur on Guam through the year 2030.

4.2.1 How Population and Employment Growth Will Impact Transportation

As discussed previously, the number of people living on Guam and the location of the jobs on Guam directly impacts the transportation system. In addition to meeting the needs of the existing residents and workers, the Government of Guam will soon be faced with meeting many new mobility needs because of the population and employment

increases in the near future. Future conditions will require that numerous improvements must be made to the roadway, transit, bicycle, and pedestrian systems on Guam.

The following impacts to Guam's roads are anticipated as a result of the Marine relocation from Okinawa:

- Population and employment growth on Guam will generate increased traffic volumes and congestion on the roadways.
- Construction of the new military facilities will greatly increase the amount and frequency of heavy construction-related trucks on the road network during the 2010–2014 build-up period. Construction vehicles will increase traffic volumes and congestion, as well as deteriorate the already substandard pavement and bridges on existing roads.
- Military truck traffic will increase as the Marine relocation begins in 2012. In addition, at the completion of military build-up, the road network will indefinitely serve the vehicles transporting military cargo from the Port of Guam and Naval Base Guam to the various military facilities on the island. These military vehicles will further increase traffic volumes, congestion, and degradation of the structural integrity of the roads.

4.2.2 Future Travel Demand Modeling Scenarios

Over the next six years, the U.S. military will move thousands of troops and their dependents to Guam. Prior to the move, considerable construction activities will occur boosting the economy in Guam. In order to quantify the impacts of the future conditions on Guam's transportation system, the existing TransCAD Guam travel demand model was used to forecast future travel conditions. The sections below provide an overview of the process. Appendix C, Model Assumptions Report, provides a full report on the assumptions and processes used to develop the travel forecasts.

The following years/scenarios were analyzed in the travel demand model:

- 2008 Baseline—this scenario compares modeled traffic volumes to observed counts that were taken in January and February of 2008. The forecasted volumes were compared to existing counts at 18 locations and were within tolerance. These new trip-generation rates were then used for the other scenarios.
- 2013 Baseline—this scenario includes normal growth on Guam to 2013.
- 2013 Peak Construction with Indirect Workers—this scenario includes the 2013 baseline with off-island indirect and construction workers plus 400 Marine personnel.
- 2013 Peak Construction without Indirect Workers—this scenario excludes off-island indirect workers but retains off-island construction workers and 400 Marines.
- 2015 Military Build-up with Indirect Workers—by 2015, it is projected that all of the military personnel and their dependents will have been relocated to Guam. The support of these troops will require an off-island labor force of approximately 13,000 people filling both indirect and construction jobs.
- 2015 Military Build-up without Indirect Workers—this scenario excludes the off-island indirect workers.

- 2030 Baseline—this scenario includes normal growth on Guam to 2030.
- 2030 Build-up—this scenario includes Year 2030 Baseline with the Marine build-up.
- 2030 Additional Build-up—this scenario includes Year 2030 Baseline with the additional Marines, Army, Air Force, and Navy personnel.

4.2.3 Baseline Scenarios

Baseline conditions are measured as a benchmark against which to compare all other scenarios. The baseline scenarios consider the future population and employment on Guam regardless of the impacts of military decisions. Demographic and socio-economic characteristics, such as population, households, school enrollment, and employment, were forecasted to 2030 by reviewing historical growth patterns and possible future economic conditions. Roadway conditions are assessed assuming that no changes are made to the existing system. Because the travel demand model is validated for 2008, this year serves as the first baseline scenario. A horizon year of 2030 and interim years of 2013 (peak construction) and 2015 (military build-up) serve as the other selected baseline scenarios.

Figure 4-8 shows the level of congestion in 2008 (this is also discussed in the Existing Conditions chapter of the GTP). The 2008 baseline scenario uses the existing network for the assignment of modeled trips. As is observed, the roads serving major residential and employment centers, such as Dededo and Tamuning, are currently the most congested. These roads are also routes that would be heavily used by the military. During both the morning and afternoon peak travel periods, the roads that have the greatest congestion levels are

- Route 2 in Agat
- Route 4 in Yona
- Route 10a in Tamuning/Barrigada
- Routes 27, 27a, and 28 in Dededo
- Route 29 in Yigo

4.2.3.1 Existing + Committed Network

The Existing + Committed (E+C) system includes the existing roadways (as in the 2008 baseline scenarios) and adds to it the committed transportation improvements. *Committed* improvements are those projects that are currently programmed for funding in the TTIP that, by all reasonable expectations, will be completed by the identified years. The only two capacity-improvement projects considered *committed* and with adequate funding for construction are as follows:

- Route 10a, Route 1 to Airport, widen from two lanes to four lanes
- Route 10, Airport to Route 16, widen from two lanes to six lanes

The GDPW has developed an extensive program of projects to address some of the most pressing transportation needs on Guam. Through TTIP, Guam is poised to spend nearly $160 million on transportation improvements over the next four years. The FY2008–FY2011 TTIP reflects the highest priority safety and system

preservation projects on Guam. The types of projects currently funded include safety improvements, bridge replacements, roadway rehabilitation, and traffic improvements. Figure 4-9 shows the locations and types of major projects that are programmed in the TTIP.

The E+C network was used for the 2013 and 2030 baseline scenarios to determine how well the roads would perform under "normal" growth conditions (i.e., no military build-up). The travel demand model produces a series of outputs that can be used to determine how well the transportation system is functioning today in comparison to the future. Vehicle miles traveled, vehicle hours traveled, delay, and speed are the performance measures that were chosen for this comparison. Table 4-3 shows the system performance for each modeled year from 2008 to 2030.

If no additional transportation improvements are made beyond what is already programmed in the E+C system, and considering only organic growth on Guam, drivers can expect to see almost a 300-percent daily increase in delay and a 3-percent decrease in traveling speed by 2030.

Figure 4-8: Baseline Congestion Levels (2008)

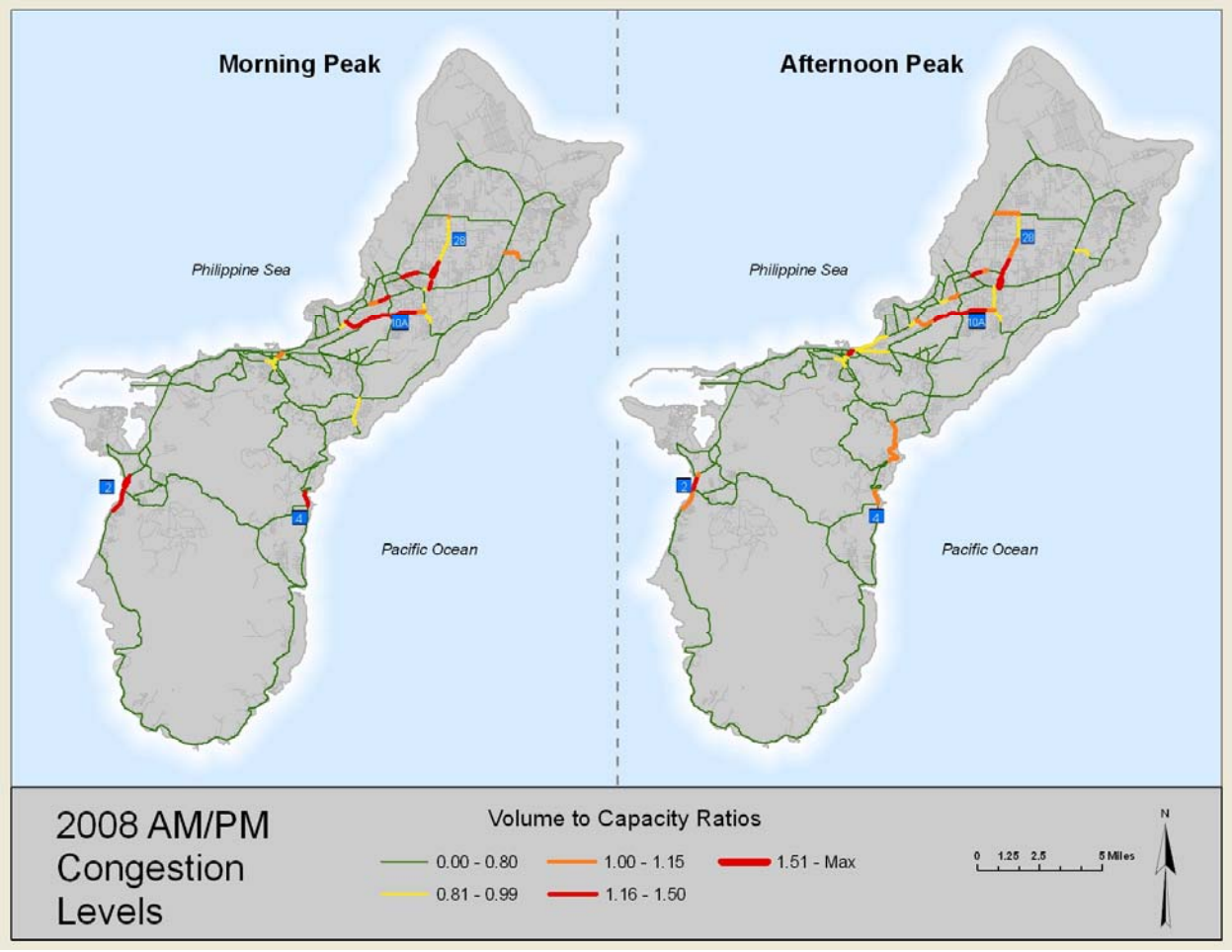


Figure 4-9: Major Territorial Transportation Improvement Program (TTIP) Projects

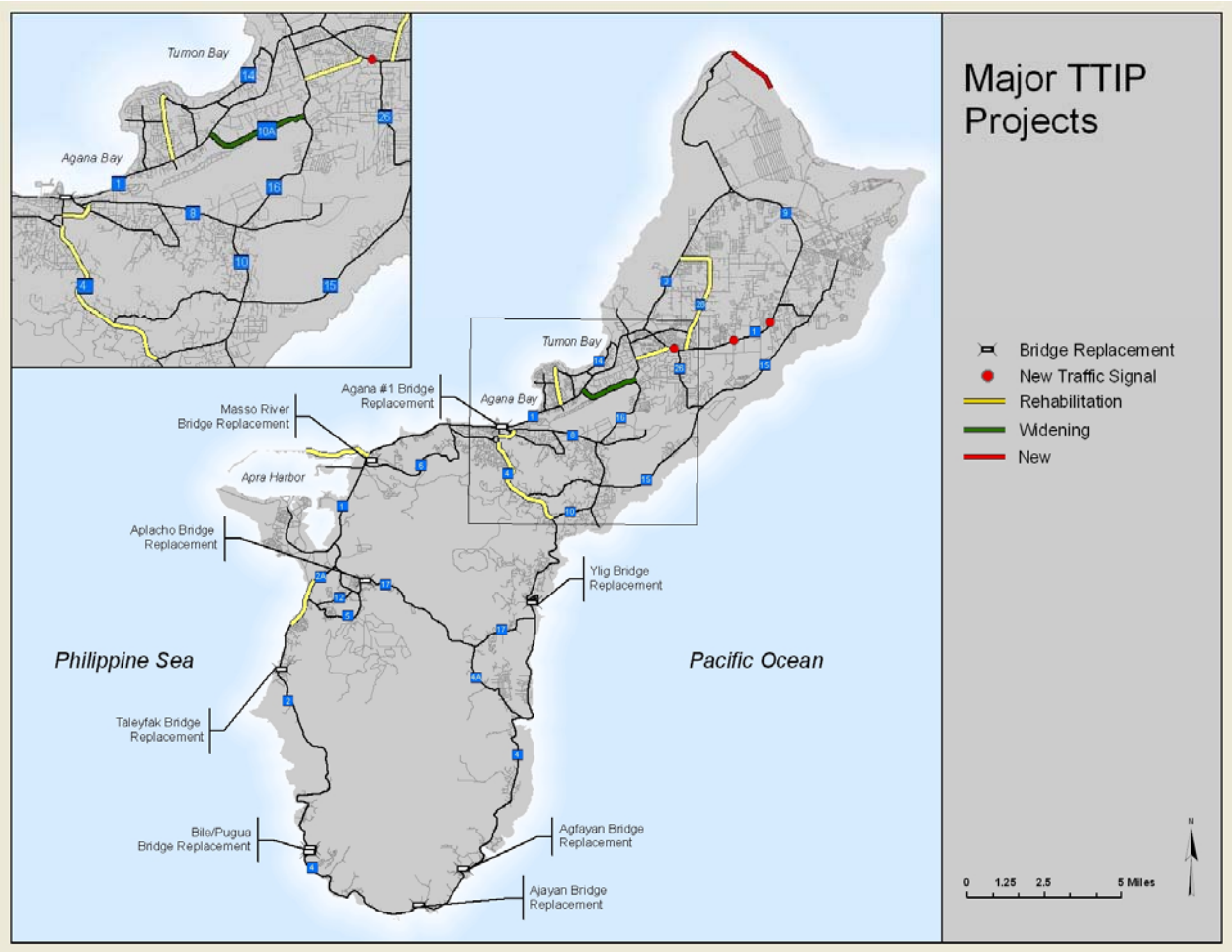


Table 4-3: E+C Transportation System Effectiveness for Baseline Scenarios

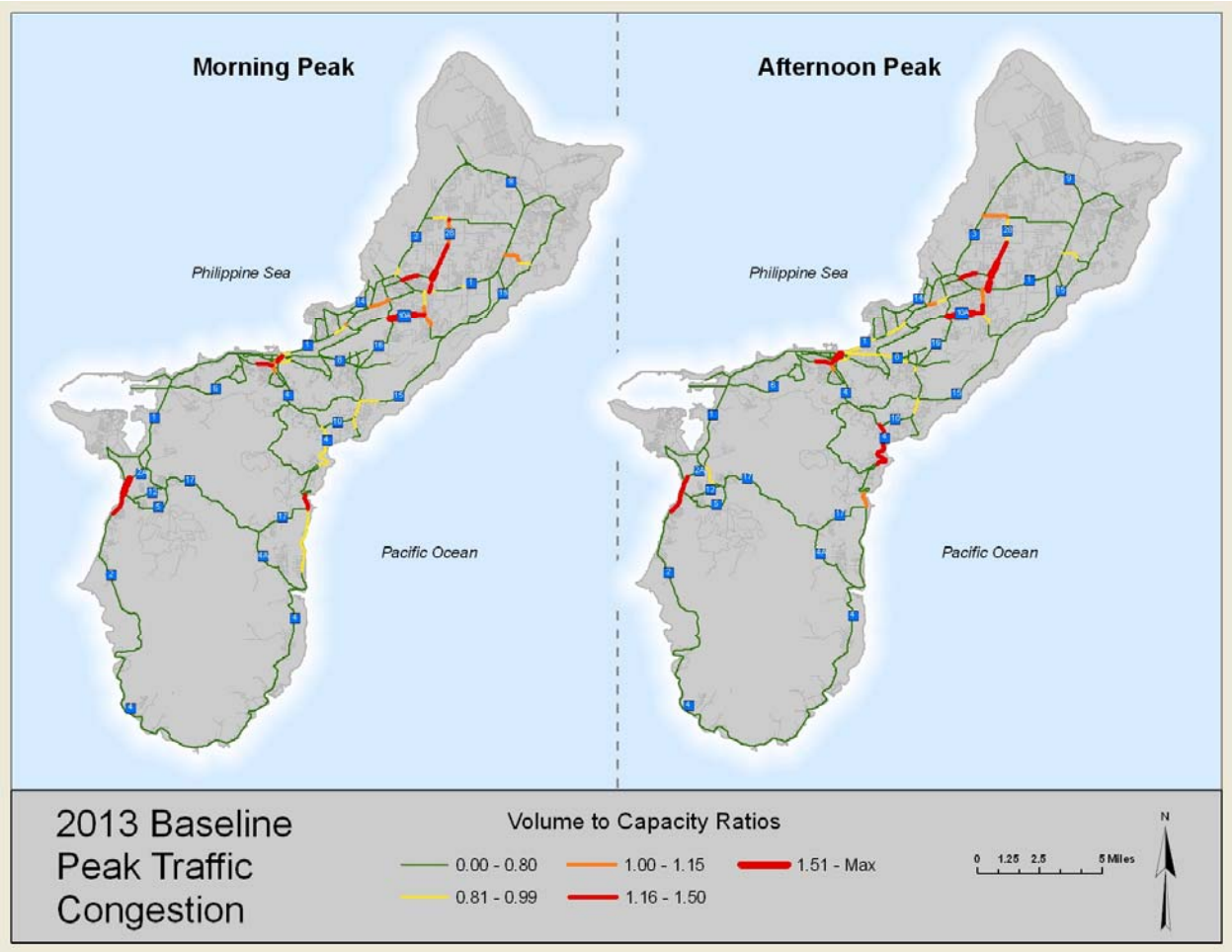
Measure of Effectiveness	2008 Existing Network	2013 E+C Network	2030 E+C Network	% Increase 2008-2030
Morning Peak Hour				
Vehicle Miles	213,281	237,705	285,723	33%
Vehicle Hours	7,475	8481	10,739	44%
Delay (hours)	358	540	1,186	231%
Speed (mph)	29	28	27	-7%
Afternoon Peak Hour				
Vehicle Miles	227,131	254,900	308,262	36%
Vehicle Hours	7,927	9,086	11,565	46%
Delay (hours)	342	552	1,232	260%
Speed (mph)	29	28	27	-7%
Off-Peak Hours				
Vehicle Miles	147,420	167,217	203,726	38%
Vehicle Hours	4,982	5,695	7,044	41%
Delay (hours)	49	91	211	330%
Speed (mph)	30	29	29	-3%
Daily Totals				
Vehicle Miles	2,649,864	2,991,811	3,632,692	37%
Vehicle Hours	90,589	103,474	129,141	43%
Delay (hours)	1,991	3,274	7,369	270%
Speed (mph)	29	29	28	-3%

4.2.3.2 2013 Baseline Scenario

The second baseline conditions scenario that was modeled was 2013. For the 2013 baseline scenario, the E+C Network was used for analysis of congestion. For modeling purposes, the only relevant committed project was the widening of Route 10a between Route 1 and Route 16. Route 10a from Route 1 to the airport will be widened to four lanes and from the airport to Route 16 the roadway will be widened to six lanes.

Figure 4-10 shows the roads that will be congested in 2013 during the morning peak travel hours and the afternoon peak travel hours.

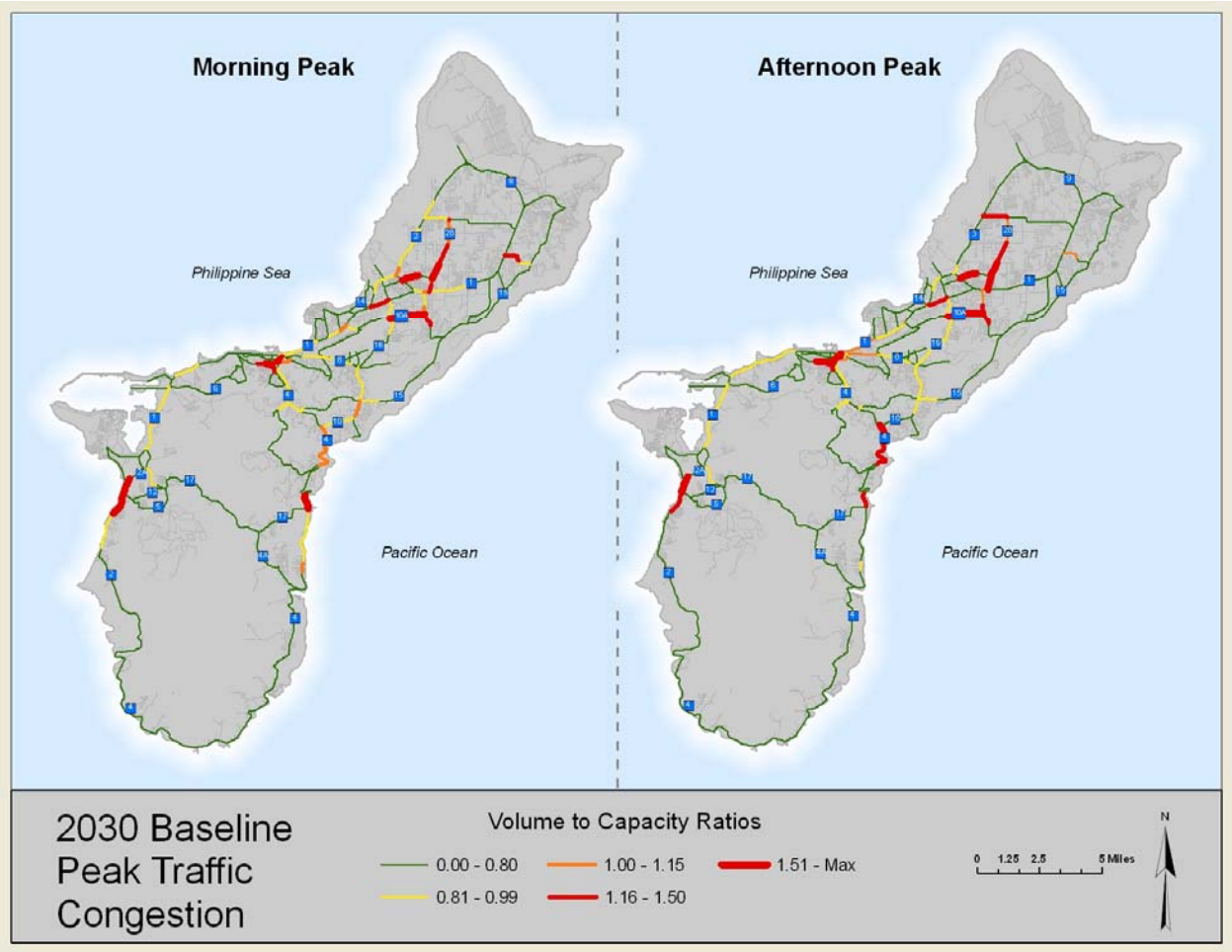
Figure 4-10: Congestion Levels—Peak Periods (2013 Baseline)



4.2.3.3 2030 Baseline Scenario

The 2030 baseline scenario was also modeled. This scenario also used the E+C Network for analysis. Figure 4-11 shows the roads that will be congested in the 2030 baseline scenario during the morning and afternoon peak travel hours compared with the congested roads in 2030 when the military-related travel impacts are considered (this is discussed further in the 2030 military build-up scenario).

Figure 4-11: Congestion Levels—Peak Periods (2030 Baseline)



4.2.4 Military Expansion Scenarios—Construction Peak (2013) and Military Build-up (2015)

The military expansion scenarios address the direct and indirect impacts on the transportation system on Guam caused by the proposed military build-up. The direct effect includes the overall increase in military personnel and activities, while the indirect effects include the number of jobs and, in turn, the number of people needed to fill those jobs, created by an increase in military population and construction. For the military expansion scenarios, the year 2030 serves as a horizon year because it is the end of military build-up, while 2013 serves as the interim year because it is the peak of military construction; 2015 serves as an interim year because it is the start of the military build-up.

According to the Census Bureau's population projections and as shown in Table 4-4, Guam's population in 2013 is expected to reach 187,753 persons. This represents an approximate 1.5-percent annual growth rate from year 2000 levels. However, in the 2013 construction peak scenario, off-island workers (construction and others) forecasted to fill the construction and indirect jobs created due to the increased military presence are

added to the local population, resulting in a total population of 215,000. By 2015, a majority of the construction workers will have left and the indirect worker population will be smaller as well; however, the Marine and Army personnel will have arrived and the population will be approximately 226,000 people.

Table 4-4: Jobs Anticipated During the Construction Peak (2013) and Military Build-up (2015)

Year	Total Construction Jobs Expected	Total Indirect Jobs Expected	USDOD Civilian Jobs filled by Guam Residents	Total Jobs
2013	15,913	20,095	250	36,258
2015	6,240	14,354	2,500	23,094

Source: Data Needs Worksheet—February 1, 2008

According to the information supplied by the military, 15,913 direct new civilian construction jobs are expected from the military build-up in 2013. In addition, the number of indirect jobs expected in 2013 is 20,095, with 15,545 workers coming from off-island to fill them. In 2015 the number of construction jobs is expected to drop to 6,240 and the number of indirect jobs is expected to be 14,354 (9,804 filled by off-island workers). There will also be approximately 5,000 direct USDOD civilian jobs by 2015.

Applying the year 2000 labor participation rate to the 2013 population gives a labor pool estimate of 86,868. Assuming the military does not increase troop levels, an unemployment rate of 15 percent was forecasted (12,880 people in the labor force would not have a job). However, assuming the planned military relocation, the unemployment rate is assumed to drop to 4 percent (3,435 unemployed persons). This implies that 9,445 existing residents become available to fill military and construction-related jobs, and 26,812 workers will be needed from off-island to fill the remaining positions. The same calculations were done for 2015 to estimate the off-island workforce. These projections are shown in Table 4-5.

Table 4-5: Workers Anticipated During the Construction Peak (2013) and Military Build-up (2015)

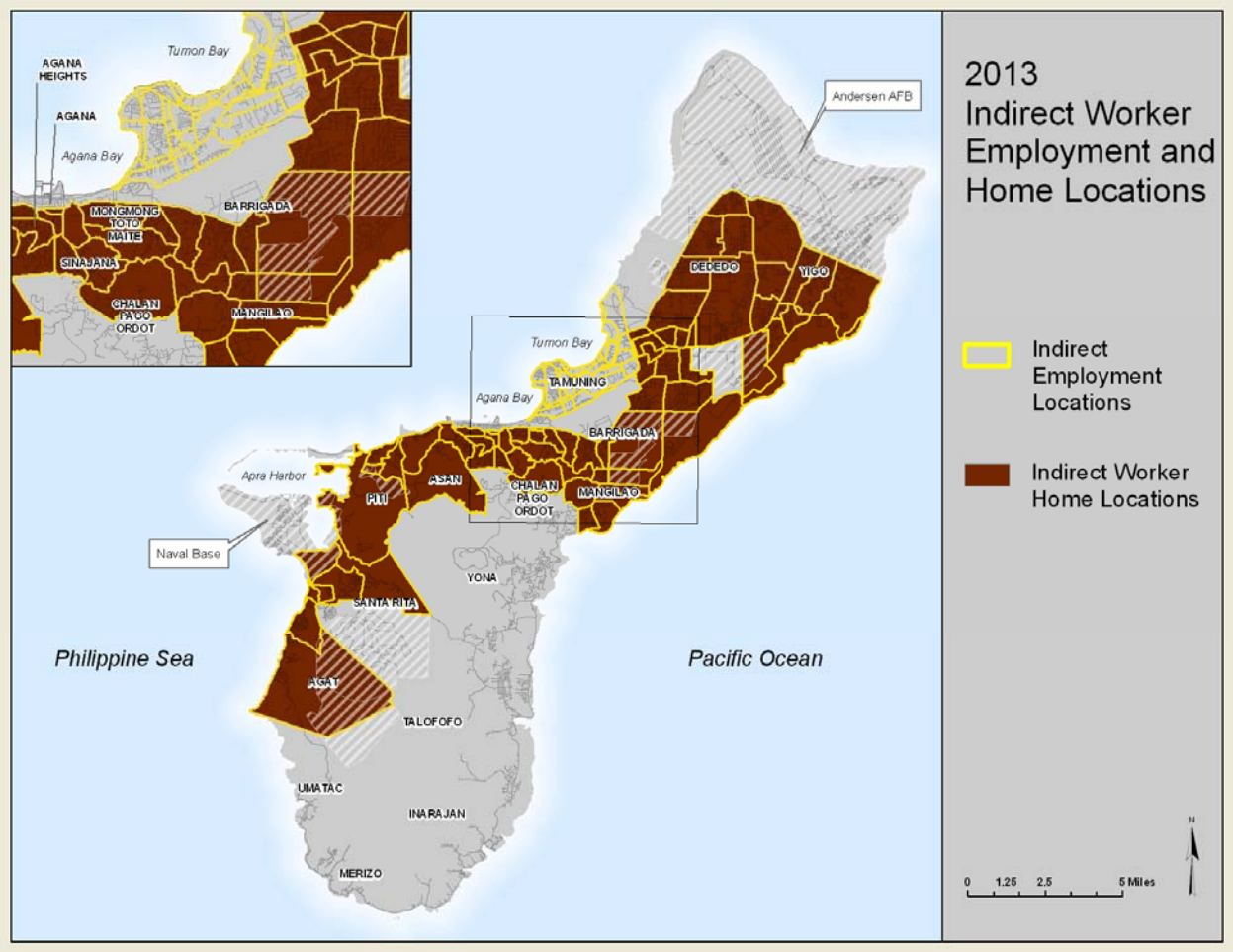
Year	Population	Labor Force	Number Unemployed—No Military Build-up	Number Unemployed—with Military Build-up	Number of Unemployed Who Become Employed Due to Military Build-up	Off-island Labor Force	Total Workers
2013	187,753	85,868	12,880	3,435	9,445	26,812	36,257
2015	192,302	87,949	13,192	3,517	9,674	13,419	23,093

Because military planners stated that 15,545 workers will come from off-island to fill the indirect jobs in 2013, it was assumed that the remaining 11,267 workers will fill the construction jobs. In 2015, 9,804 off-island workers will fill indirect jobs (3,615 workers are filling construction jobs).

4.2.4.1 Home Locations of Indirect Workers

The off-island workers coming to Guam to fill the indirect jobs were located near the construction sites based on the 2013 forecasted population distribution. It was assumed that these workers would not bring additional members of their families but that they would live together forming households of various sizes in order to economize. It was assumed that they would be responsible for their own transportation to and from their work locations and that they would make home-based other and non-home-based trips at the same rates as other Guam residents. The presence of these households contributes to the number of commercial vehicle trips produced as well. Figure 4-12 shows the location of the indirect workers as well as where the indirect jobs will be located.

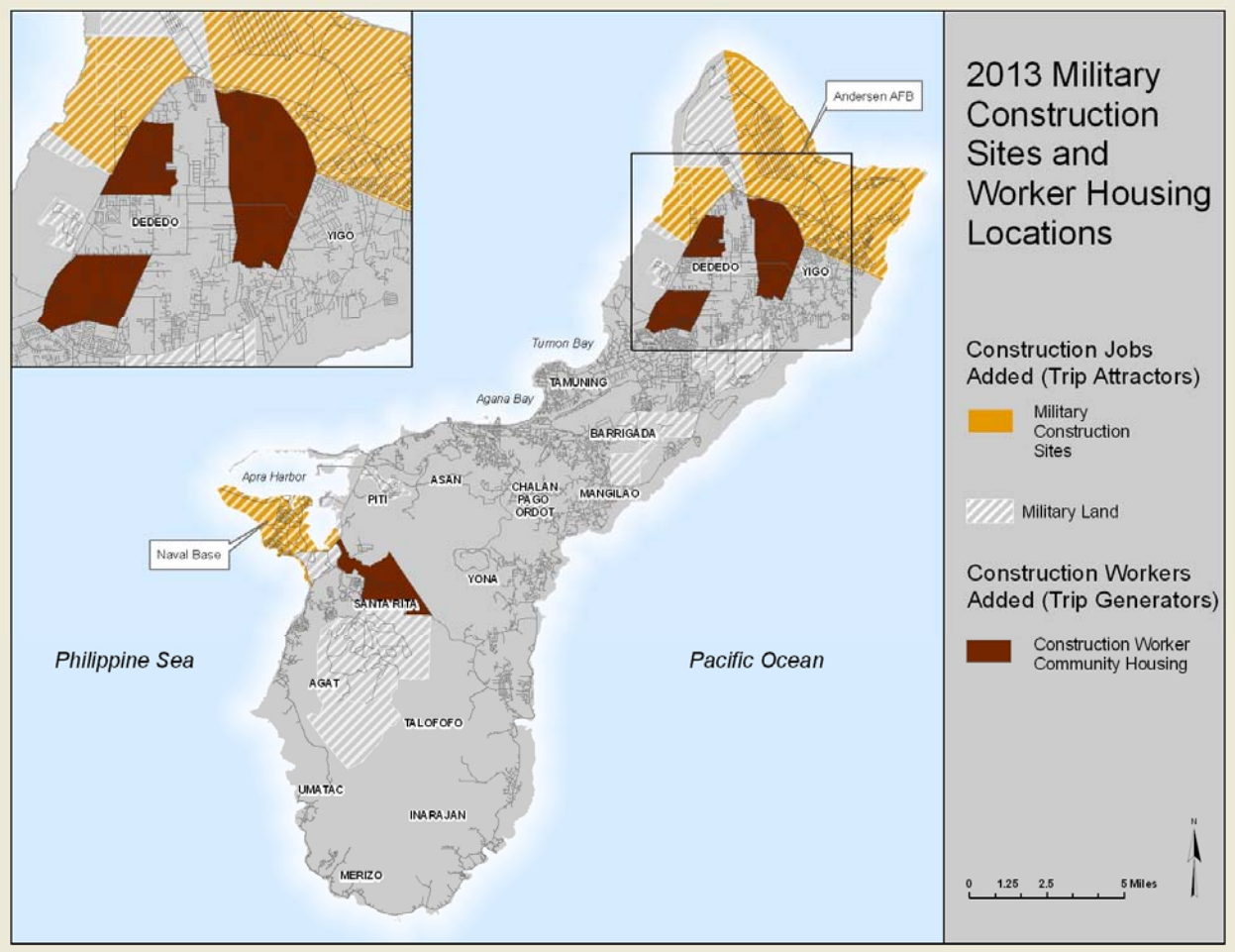
Figure 4-12: Indirect Workers—Home and Employment Locations



4.2.4.2 Indirect Jobs

The military planners estimated the total of indirect jobs but did not break the jobs into industry categories used in the model. Because retail employment has a greater weight than hotel or other employment in determining trip distribution, 30 percent of the indirect jobs were assigned to the "retail" category and the rest were classified as "other." The split was based on historical proportions. These new jobs were distributed for modeling purposes to areas in the Northern and Central part of the island based on the 2013 forecasted employment locations as shown in Figure 4-13.

Figure 4-13: Location of Jobs and Housing



4.2.4.3 Home Location of Construction Workers

The construction workers coming from off-island were assumed to live in community housing in areas near the major construction areas (NCTS Finegayan, Andersen Air Force Base, and Naval Base Guam) but not directly on base. They will be transported to the worksites using a fleet of 10-passenger vans, 20-passenger shuttles, and 40-passenger buses during off-peak hours.

4.2.4.4 Construction Jobs

The over 15,000 projected construction jobs were classified as "other." Since the majority of those jobs are filled by the off-island workers whose work trips are being accounted for explicitly, only the jobs filled by Guam residents were added to the locations of the three main construction sites: Andersen Air Force Base, NCTS Finegayan, and Apra Harbor. The resident jobs were proportioned based on the total construction dollars spent at each site.

4.2.4.5 Construction Materials and Vehicles

Construction materials and vehicles were also accounted for in the modeled scenarios. This was based on a draft of the *Port of Guam Master Plan*, which took into consideration a military expansion 50 percent larger than is now expected, and an analysis of the amount of construction anticipated based on existing building footprints in Okinawa. Background construction truck traffic between the port and roadway construction sites was estimated to be 400 trips per day. In addition, 900 trucks per day were forecasted to travel between the commercial port and the military bases. Almost 90 percent of truck traffic was estimated to occur outside of peak traffic periods.

4.2.4.6 Training Movements and Other Military-related Trips

Finally, trips produced by the military base were considered. These included trips for training exercises by the troops and recreational, shopping, and errand trips by family members. Military training exercises are scheduled daily and in three-week blocks throughout the year. Trips for training exercises involve buses and privately-owned vehicles during the morning and afternoon peak travel periods, with trucks making trips in the off-peak periods. Of the family trips, 75 percent were assumed to go from one military base to another with the remaining 25 percent to other destinations on the island.

4.2.4.7 Military Impacts on Traffic Conditions in 2013 and 2015

Traffic flows will significantly increase during the construction period along critical routes, such as Route 1 and Route 3 between the Port of Guam and NCTS Finegayan. Figure 4-14 shows the extent of these impacts. The orange and red lines indicate significant increases in traffic, from a 50 percent increase to more than 250 percent over current 2008 levels.

Figure 4-14: Traffic Increases Attributable to the Military Build-up (2013)

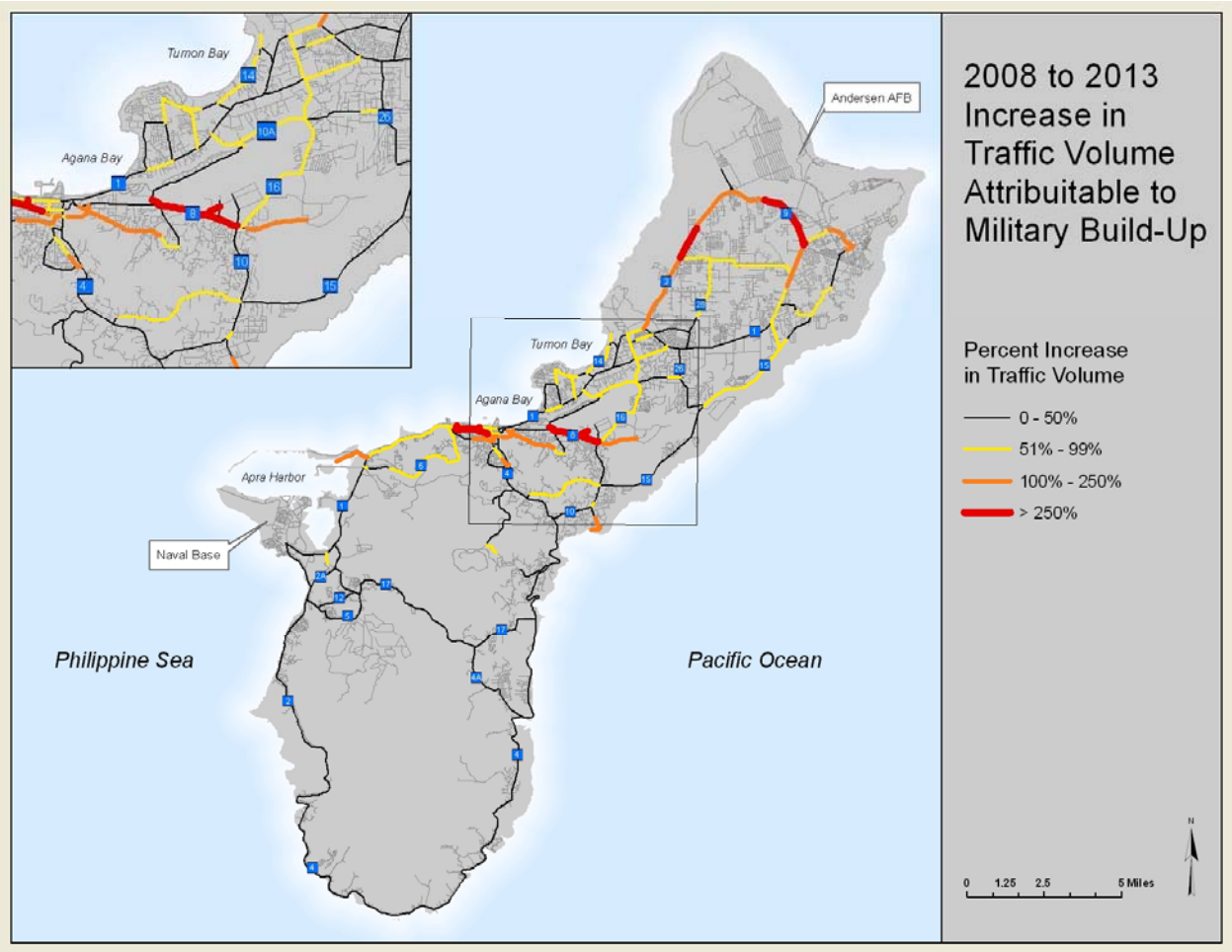
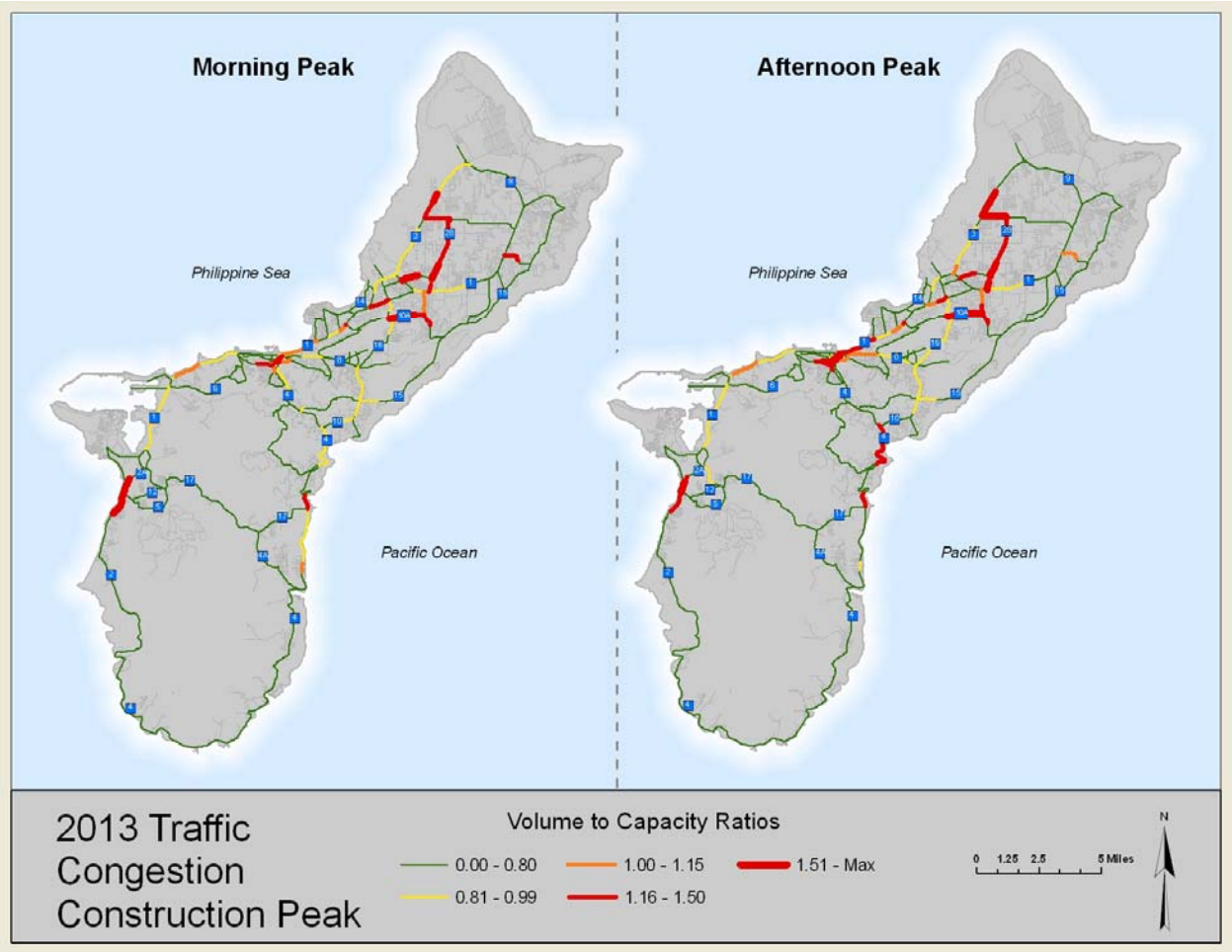


Figure 4-15 and Figure 4-16 show the congestion levels expected during the Construction Peak (2013) and the start of the Military Build-up (2015), respectively. In 2013, conditions are not expected to be much worse than what was seen in the baseline condition. This is mainly because it was assumed that movement of construction workers will be facilitated by vans, shuttles, and buses instead of personally owned vehicles and limited to off-peak hours. Also, the truck movements, while they significantly add to the wear and tear of the pavement, do not contribute much to the levels of congestion on the island as most of the trips are made in the off-peak time period.

Figure 4-15: Congestion Levels in 2013 (Military Build-up)



By contrast, in 2015 at the start of the military build-up, there is a significant increase in the levels of congestion, particularly in the northern part of the island. This is attributable to the increased numbers of military personnel and construction traffic around the NCTS Finegayan and Andersen Air Force Base areas. Figure 4-16 shows the a.m. and p.m. peak period levels of congestion.

Figure 4-16: Congestion Levels in 2015 (Military Build-up)

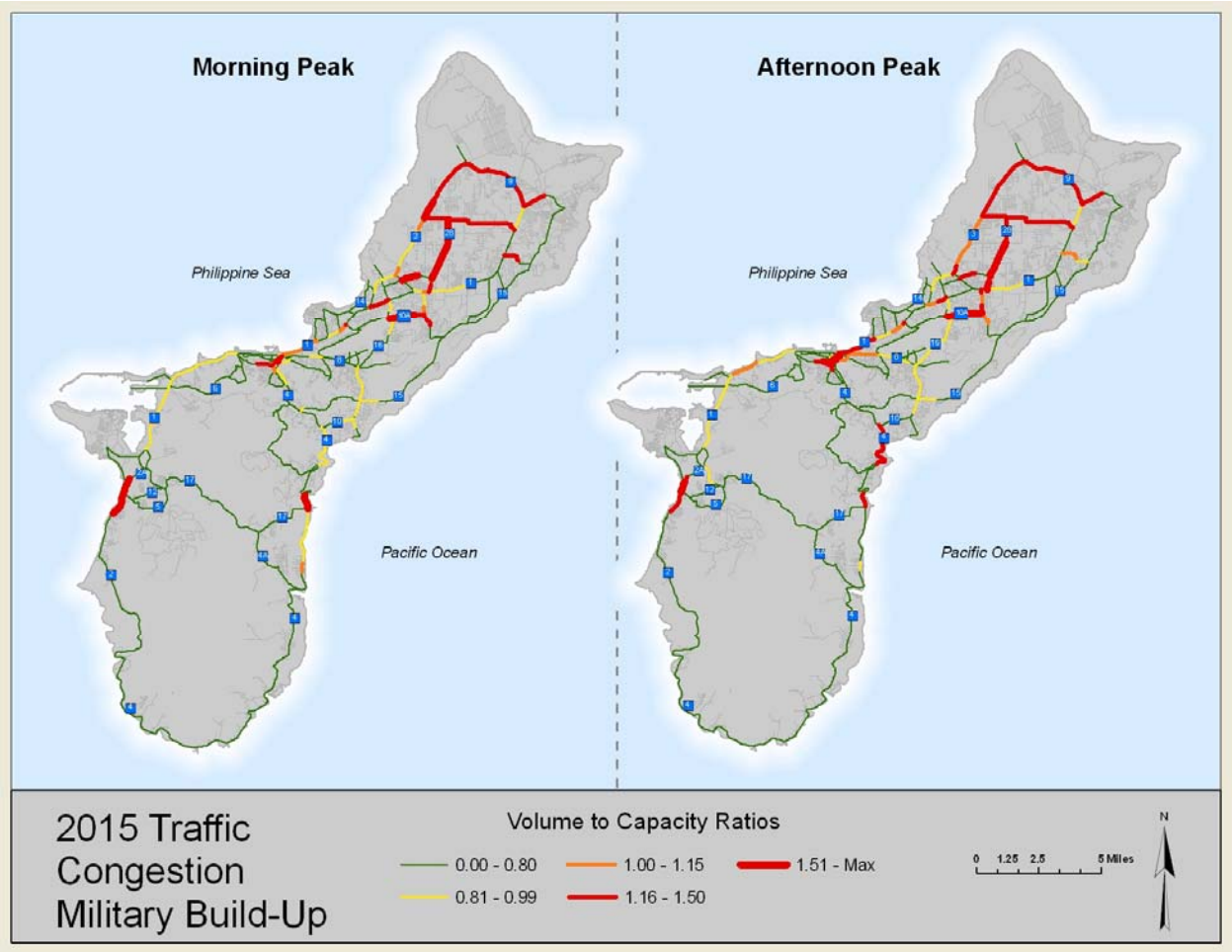


Table 4-6 lists the performance measures of VMT, VHT, VHD, and speed as they are projected by the travel demand model. The comparison of the 2013 construction peak and the 2015 military build-up measures to the 2013 baseline measures shows the magnitude of the congestion increase. Looking at the hours of daily delay, it is projected that there will be an increase of more than four times what would be expected without the military presence. As these numbers show, the military build-up will have significant impact on how the roadways will function in the future.

Table 4-6: Construction Peak (2013) and Military Build-up (2015) Transportation System Effectiveness

Measure of Effectiveness	2013 Baseline E+C Network	2013 Construction Peak E + C Network	2015 Military Build-up E+C Network
Morning Peak Hour			
Vehicle miles	237,705	293,254	317,190
Vehicle hours	8481	11,119	13,321
Delay (hours)	540	1,351	2,723
Speed (mph)	28	26	24
Afternoon Peak Hour			
Vehicle miles	254,900	323,084	343,919
Vehicle hours	9,086	12,462	14,749
Delay (hours)	552	1,674	3,237
Speed (mph)	28	26	23
Off-Peak Hours			
Vehicle miles	167,217	2,30,066	228,628
Vehicle hours	5,695	8,238	8,294
Delay (hours)	91	550	655
Speed (mph)	29	28	28
Daily Totals			
Vehicle miles	2,991,811	399,3467	4,065,758
Vehicle hours	103,474	14,6021	155,665
Delay (hours)	3,274	12,648	19,782
Speed (mph)	29	27	26

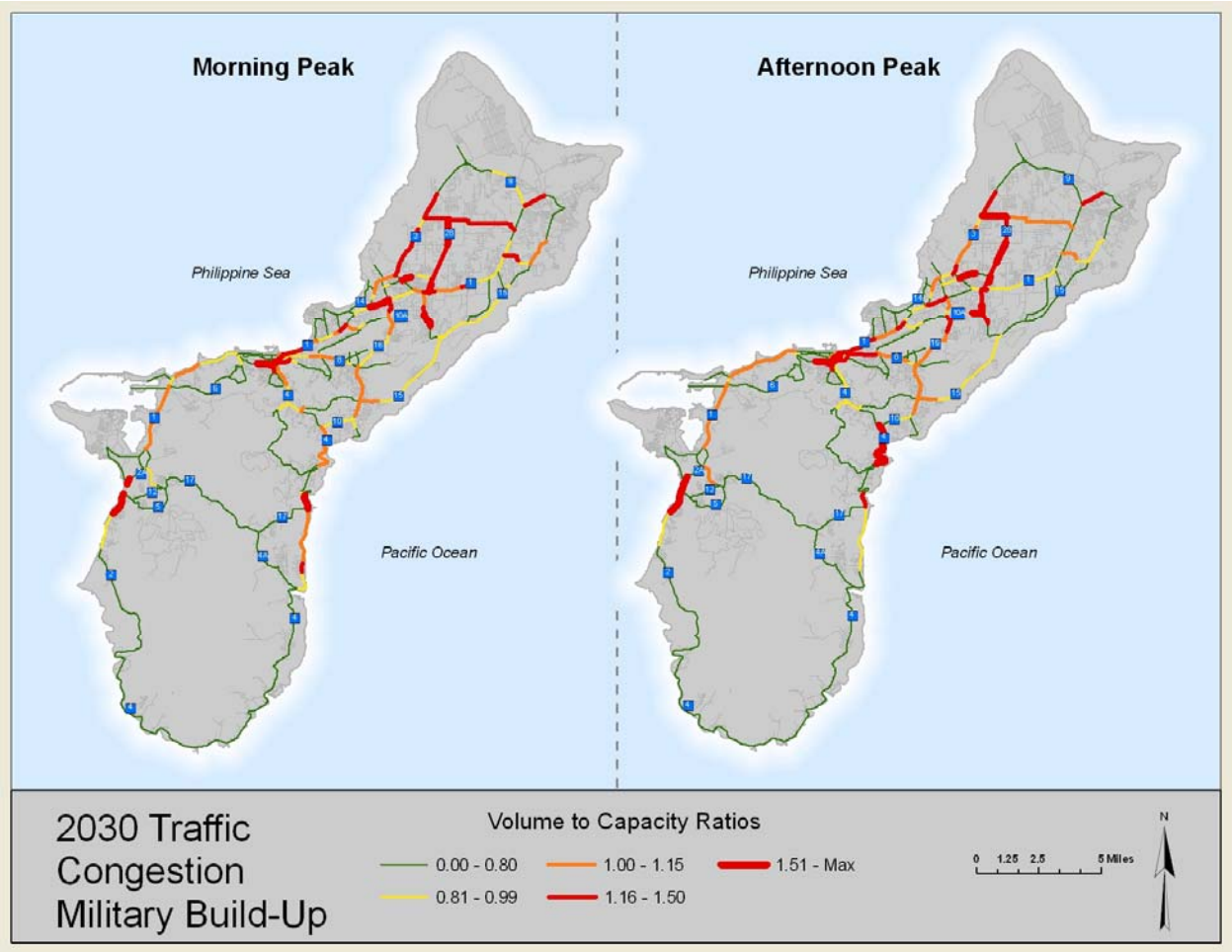
4.2.5 2030 Full Population

Forecasted population and employment levels were used in the travel demand model to estimate 2030 traffic volumes for each segment of the roadway system. Future congestion conditions were then calculated based on the capacities of the E+C Network and can be seen in Figure 4-17.

By 2030, with population reaching 253,000, peak-period traffic congestion is expected on the major roads serving military and tourist areas.

As shown in Figure 4-17, excessive congestion will be seen on several key roadways on Guam by 2030. Most notably, Route 28, Route 27a, Route 26, and Route 25 in the Dededo district will be congested as more residential development is expected. Route 27a Extension to Route 1, also known as “Hamburger Highway,” will be congested as motorists look for an alternative route to Route 1 in Tamuning. Route 2 in Agat and Route 4 in Chalan Pago and Yo’ña will also experience significant increases in congestion. In order to improve operating conditions during peak hours, improvements are recommended for these roadways.

Figure 4-17: Congestion Levels with Military Build-up (2030)



4.3 Mass Transit and Bicycle and Pedestrian Facilities

It is anticipated that the anticipated 44 percent increase in population and employment by 2030 will raise the demand for alternative modes of transportation, such as transit, bicycling, and walking, as well as auto usage. Transit and non-motorized modes of transportation will provide an important choice to Guam residents and provide an opportunity to reduce traffic congestion on roadways.

4.4 Findings

Guam is facing unprecedented challenges in regards to future transportation needs. As the baseline scenarios show, traffic conditions on Guam are going to deteriorate if enhancements are not made to the existing system. Added to this is the additional strain of the military build-up on Guam. As the last several figures show, starting in 2013 and peaking in 2030, congestion levels on Guam are going to significantly increase due to the military presence. The transportation plan must, therefore, address all the major components of the system—not only the highway network but the transit system and pedestrian and bike systems as well. The following chapter highlights the recommendations for ensuring that the Guam transportation system meets the future needs of all Guam residents.

5.0 NEEDS ASSESSMENT (UNCONSTRAINED)

5.1 Introduction

Over the next six years, Guam will experience extraordinary growth that will place a tremendous strain on its infrastructure. The specifics of the growth and the resulting impacts have been discussed in depth in the previous chapters. This chapter provides an overview of the improvements needed to improve the future transportation system and the process by which these recommendations were reached. These improvements encompass a broad spectrum of transportation system needs on Guam and are not constrained by fiscal limitations. The reality, however, is that funding is limited. As such, the recommended improvements in this chapter will become the basis from which the financially constrained plan is developed in Chapter 7, Policy Recommendations.

GDPW's priority is to maintain, preserve, and enhance Guam's existing transportation system. In order to do so, the first priority projects will need to include projects such as bridge replacements, geometric (horizontal and vertical) road improvements, pavement repair and replacement, intersection improvements, and traffic signal enhancements. The impacts of the anticipated population and employment increases as a result of the military build-up will make these projects all the more critical as the additional traffic on the roads will further deteriorate the transportation system and reduce the level of service on the roadways.

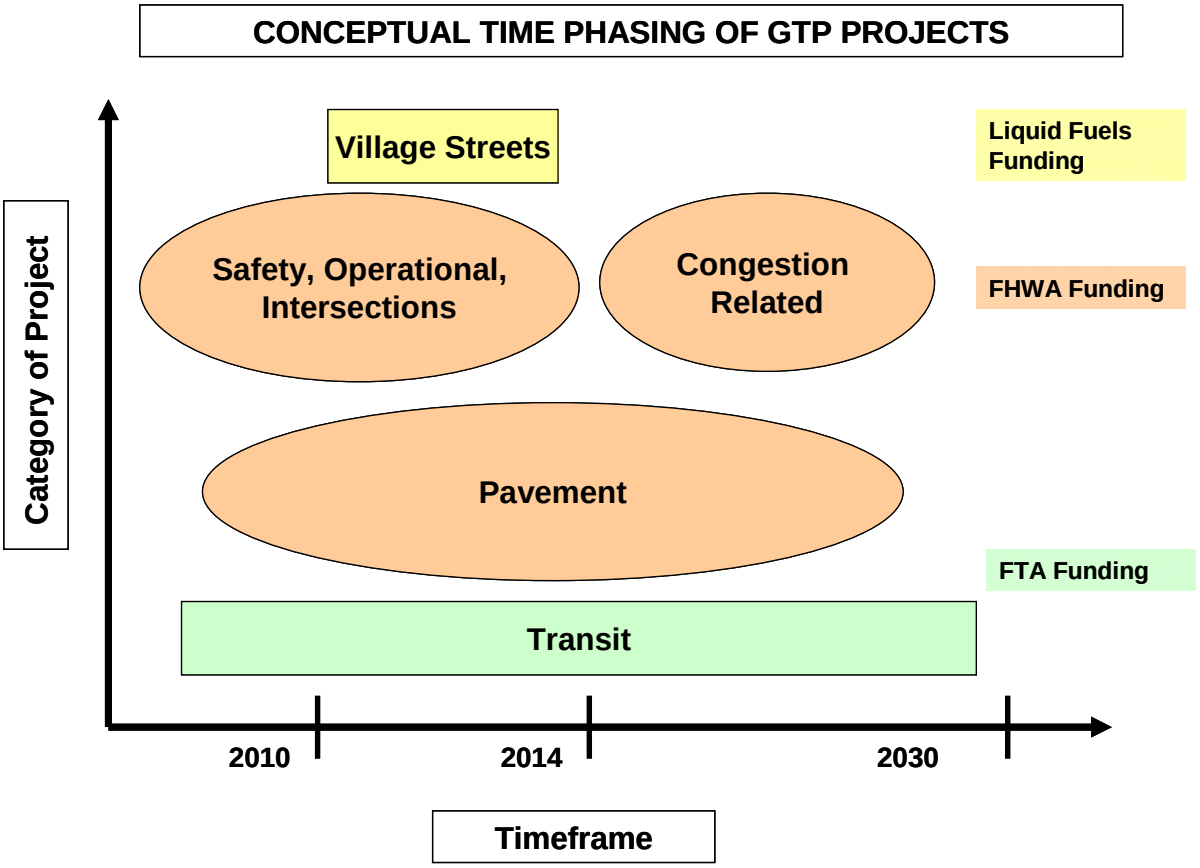
Congestion-related improvements will also be required to maintain reasonable levels-of-service on the roads during peak hours and throughout the day. Tier 1 congestion-relief projects have been identified to address the most severely congested roadways. A second tier of congestion-relief projects has also been identified to further address congested roadways.

There is more that is required to make Guam an efficient and well-rounded system for transportation than just improvements to existing roadways. The GTP is a multi-faceted transportation plan that will address the future travel demands on Guam, including transportation systems management, travel demand management, roadway improvements, transit, and bike/pedestrian improvements. The goal of this approach is to maximize the usage of the current system, provide additional capacity where required, and provide additional modes of transportation, such as transit, bicycle, and pedestrian networks.

Figure 5-1 provides a graphic representation of the relative timing of recommended improvement projects over the life of the GTP. The graphic serves as a visual representation of the policy guide for how the GDPW will carry out the transportation improvement projects. Safety, operational, and intersection improvements take first priority and will be started first; transit projects will be done concurrently with separate funding from FTA; new village streets projects will then begin following the new issuance of a bond backed by liquid fuels tax revenue; Haul Road projects will follow with separate funding from the USDOD; and congestion-related projects will be the final element.

Also shown in this figure are general funding categories associated with each type of improvement project. The funding element will be described in detail in Chapter 6, Can We Afford It?

Figure 5-1: Relative Importance of GTP Projects



5.2 Types of Needed Improvements

5.2.1 Safety, Operational, and Intersection Improvements

These projects include efforts to improve safety and maximize the capacity of the existing system. They include bridge modifications, pavement maintenance, lane restriping, installation of raised medians to control access, optimization of the traffic signal control system, upgrade of the traffic operations center, and minor intersection improvements, such as additional right-turn and left-turn lanes. Most of these items are low-cost compared to major roadway-widening projects, require little or no additional right-of-way, cause no significant environmental impacts, and generally do not require extensive environmental clearance processes. Several examples include:

- Coordination of traffic signals to improve level of service
- Upgrade of the traffic operations center
- Minor intersection improvements
- Repair/replacement of bridges

5.2.2 Congestion-related Improvements

These improvement projects are designed to alleviate long-term congestion issues on the roadways and are based on population and employment projections for 2030. They typically involve widening existing roads or building new roads. Congestion-related improvements can have a greater impact on the surrounding properties as they often require additional right-of-way and can disrupt traffic movements while construction is underway. Environmental studies are generally required to determine the level of impacts and additional permits that may be required. Some of the key characteristics of congestion-related improvements include:

- Improving traffic flow and roadway safety
- Improving roadways operating at poor levels of service

5.2.3 Transit, Bicycle, and Pedestrian Improvements

Improvements related to transit, bicycle, and pedestrian facilities provide a variety of travel mode choices. These projects will help to ensure all the transportation needs of the population are met. As fully described in Section 5.6, Mass Transit Improvements, recommended projects include the purchase of additional transit vehicles, improved route service, bicycle lanes, and sidewalks. In order to provide an enhanced transportation system, as well as to comply with federal law, Guam will provide pedestrian and bicycle facilities on all new or reconstructed roadways in the future. Benefits of providing a variety of modes of transportation include:

- Lessened environmental impacts due to fewer emissions from single-occupancy vehicles
- Reduced wear and tear on the roadways
- Improved health benefits to bicyclists and pedestrians

5.2.4 Village Streets Improvements

Village streets are those local roads that do not carry high volumes of traffic, are typically found within residential neighborhoods, and generally provide connections to neighborhood destinations as opposed to large-scale shopping or employment centers. Village streets also provide linkages to the federal roads. Improvements to the village streets are generally related to preservation, maintenance, paving of gravel roads, and safety.

5.2.5 Roadway Rehabilitation

Rehabilitation or reconstruction improvements are smaller-scale projects to improve the condition of existing roadways. Typical rehabilitation improvements include milling, resurfacing, and replacing damaged concrete.

5.3 Haul Road Network

5.3.1 Overview

The United States 3rd Marine Corps Expeditionary Forces Air Combat Element, Command Element, Ground Combat Element, and Command Service Element will relocate from Okinawa, Japan to Guam with a projected schedule of completing the relocation by 2015. Additionally, the U.S. Army Ballistic Missile Defense Task Force is being located to the island. The build-up includes accommodating additional logistics capabilities for military training and operations, and improving pier/waterfront infrastructure for transient U.S. Navy nuclear aircraft carriers berthing at Naval Base Guam.

The impacts of the military build-up on Guam are far-reaching. The implications of the projected 20 years of growth in only 5 years will place an incredible strain on Guam's transportation infrastructure. In addition to the needs of the general population, the military itself will require an enhanced road network that can support its heavier-weight vehicles and the military-related construction traffic that will be generated as sites are prepared for military operations. The military activities will increase traffic volumes and increase vehicular cargo weights beyond current levels. The roadway infrastructure in Guam is unable to handle the added traffic and the added weight of loads expected to support both the construction of the military base and to support ongoing military operations.

The concept of a Haul Road Network (HRN) grew from identifying the routes most likely to be used by the military in connecting known origins and destinations. In this fashion, routes used by the military would be pre-determined, impacts localized to those roadways, causing the need for improvements to be restricted to the identified network. The HRN is a series of priority roads for the military that provide connectivity between the commercial Port of Guam, Smith Rock Quarry, Andersen Air Force Base, and the NCTS Finegayan and South Finegayan sites. The HRN, when fully improved, will have the traffic capacity and structural integrity to withstand the movement of military and civilian traffic and cargo loads of truck traffic during the build-up period.

It is assumed that the military will fund the projects required for HRN operations. However, it is important to discuss in the GTP because the HRN improvements are an essential element of a well-functioning transportation system on Guam. The discussion below provides a summary of how the HRN was developed and what it includes. For complete details regarding the analysis and identified projects, refer to Appendix H, Defense Access Roads Needs Report.

5.3.2 Haul Road Network Components

The key component of the HRN is a strengthened bypass on the Route 8/Route 16 corridor on the easterly side of the Guam International Air Terminal. This by-pass route provides a good alternative for moving cargo across the island rather than on the normally congested Route 1 corridor through Tamuning. The primary truck route between the Port of Guam, NCTS Finegayan and Anderson Air Force Base consists of Route 1 from the Port to Route 8, Route 8 to Route 16, Route 16 to Route 27, Route 27 back to Route 1, Route 1 to Route 3 and Route 3 to Finegayan. Trucks moving cargo from the intersection of Route 1/Route 27 would have the option of using Route 1 or Route 3 to access the various Andersen Air Force Base gates.

Other major truck routes include Route 3 north of NCTS Finegayan and Route 9, which provide access to Northwest Field and Andersen Air Force Base. Another key connection is along Route 15 and Chalan Lujuna, which will connect the Rock Quarry, providing aggregate to the military construction sites, to the remainder of the HRN. The HRN is shown in Figure 5-2.

As discussed above, the Haul Roads will be of critical importance to the military and military-related construction activities on Guam. New traffic counts were collected on the Haul Road in 2008. The counts are referred to as average daily traffic and are shown in Table 5-1.

Figure 5-2: Haul Road Network

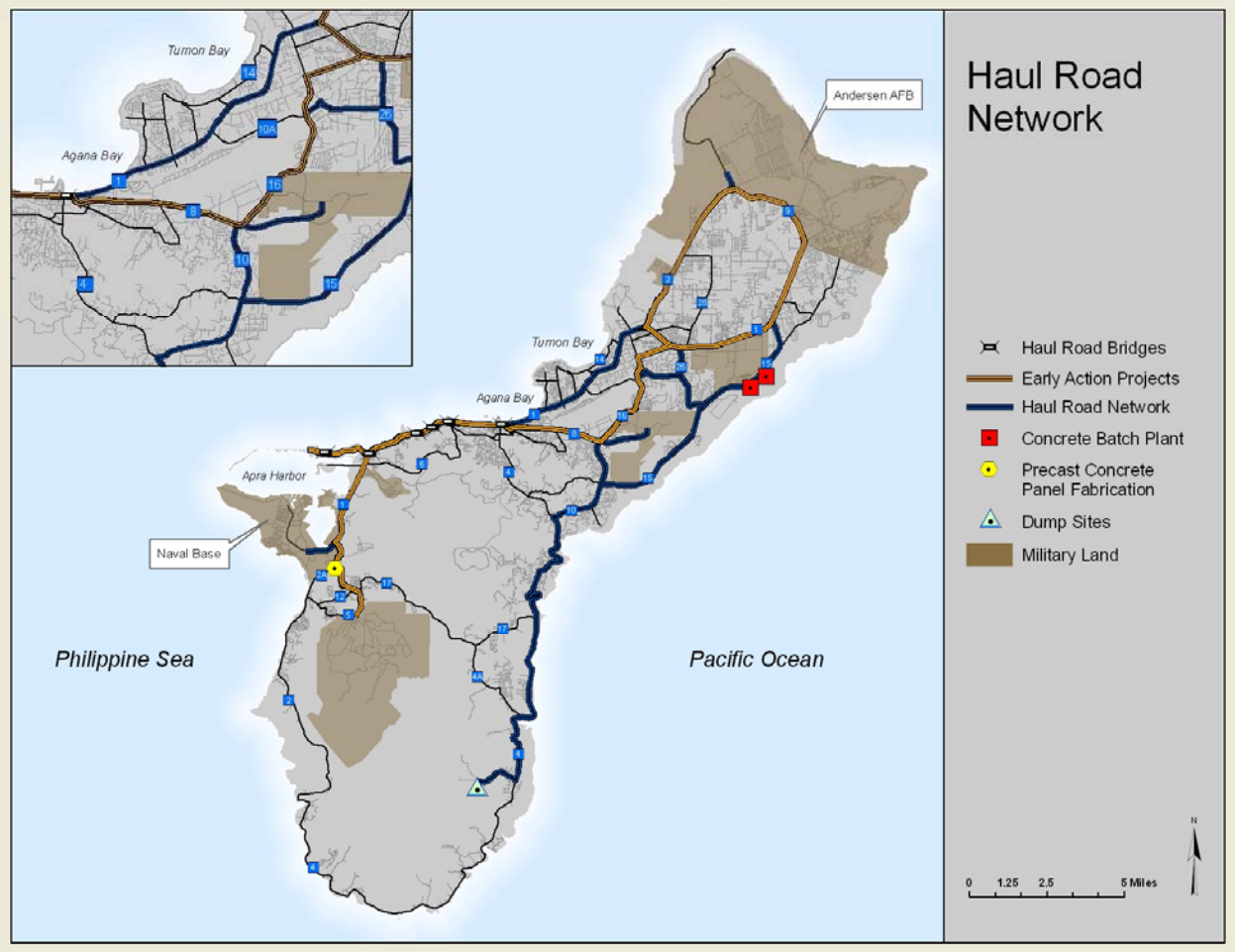


Table 5-1: Traffic Counts on Haul Roads

2008		Highway			Daily
ID	DIR	Number	Route Name	Village	Volume
2	N	Route 1	Marine Drive	Piti	9,877
2	S	Route 1	Marine Drive	Piti	10,644
3	E	Route 1	Marine Drive	Asan	13,972
3	W	Route 1	Marine Drive	Asan	13,022
4	N	Route 1	Marine Drive	Maite	22,369
4	S	Route 1	Marine Drive	Maite	23,215
10	E	Route 1	Marine Drive	Dededo	16,685
10	W	Route 1	Marine Drive	Dededo	16,796
9	E	Route 1	Marine Drive	Yigo	6,726
9	W	Route 1	Marine Drive	Yigo	7,062
18	N	Route 4	San Isidro	Talofofo	2,103
18	S	Route 4	San Isidro	Talofofo	2,156
17	N	Route 4	Chalan Canton Tasi	Yona	2,839
17	S	Route 4	Chalan Canton Tasi	Yona	2,840
16	N	Route 4		Yona	7,354
16	S	Route 4		Yona	7,615
15	N	Route 10		Mangilao	13,740
15	S	Route 10		Mangilao	13,733
14	N	Route 10		Barrigada	11,727
14	S	Route 10		Barrigada	14,117
6	N	Route 16		Barrigada	17,968
6	S	Route 16		Barrigada	17,460
5	E	Route 8	Ramirez Way	Barrigada and Aspengao	16,728
5	W	Route 8	Ramirez Way	Barrigada and Aspengao	16,813
7	N	Route 3	Chedo Street	Dededo	9,567
7	S	Route 3	Chedo Street	Dededo	10,614
8	E	Route 9	Azud Avenue	Yigo	2,133
8	W	Route 9	Azud Avenue	Yigo	2,301
1	N	Route 5	Pedro Roberto Drive	Apra Heights	3,313
1	S	Route 5	Pedro Roberto Drive	Apra Heights	3,345
13	N	Route 15	Chalan Padiron Haya	Mangilao	4,503
13	S	Route 15	Chalan Padiron Haya	Mangilao	4,703
11	N	Route 15	Chalan Padiron Haya	Mangilao	2,897
11	S	Route 15	Chalan Padiron Haya	Mangilao	3,547
12	N	Route 26	Carnation Avenue	Barrigada	11,196
12	S	Route 26	Carnation Avenue	Barrigada	10,668

5.3.3 Haul Road Network Improvements

In order to determine the needed improvements to the HRN, a traffic analysis, pavement analysis, and bridge analysis were completed. These studies analyzed the existing conditions of the road segments independently to determine which will face the greatest impacts in terms of amount of traffic and wear and tear on the pavement and structural elements. Full details are included in Appendix H, Defense Access Road Needs Report.

Based on detailed analyses of the existing roads and projections of future needs, as well as discussions with the Government of Guam, FHWA, and the U.S. Navy, required improvements were identified. Required improvements generally fall into one of the following categories:

- Pavement strengthening
- Roadway widening
- Intersection improvements
- Bridge replacement

The entire list of proposed HRN improvements is shown in Table 5-2 and will be implemented based on funding availability.

From the full list of improvements needed on the HRN, a priority listing of projects was developed and targeted for implementation in FY2010. The Early Action Projects make up an infrastructure backbone that supports the construction activities necessary for the military build-up. The majority of the construction efforts will be located in the NCTS Finegayan area and in northwestern Guam.

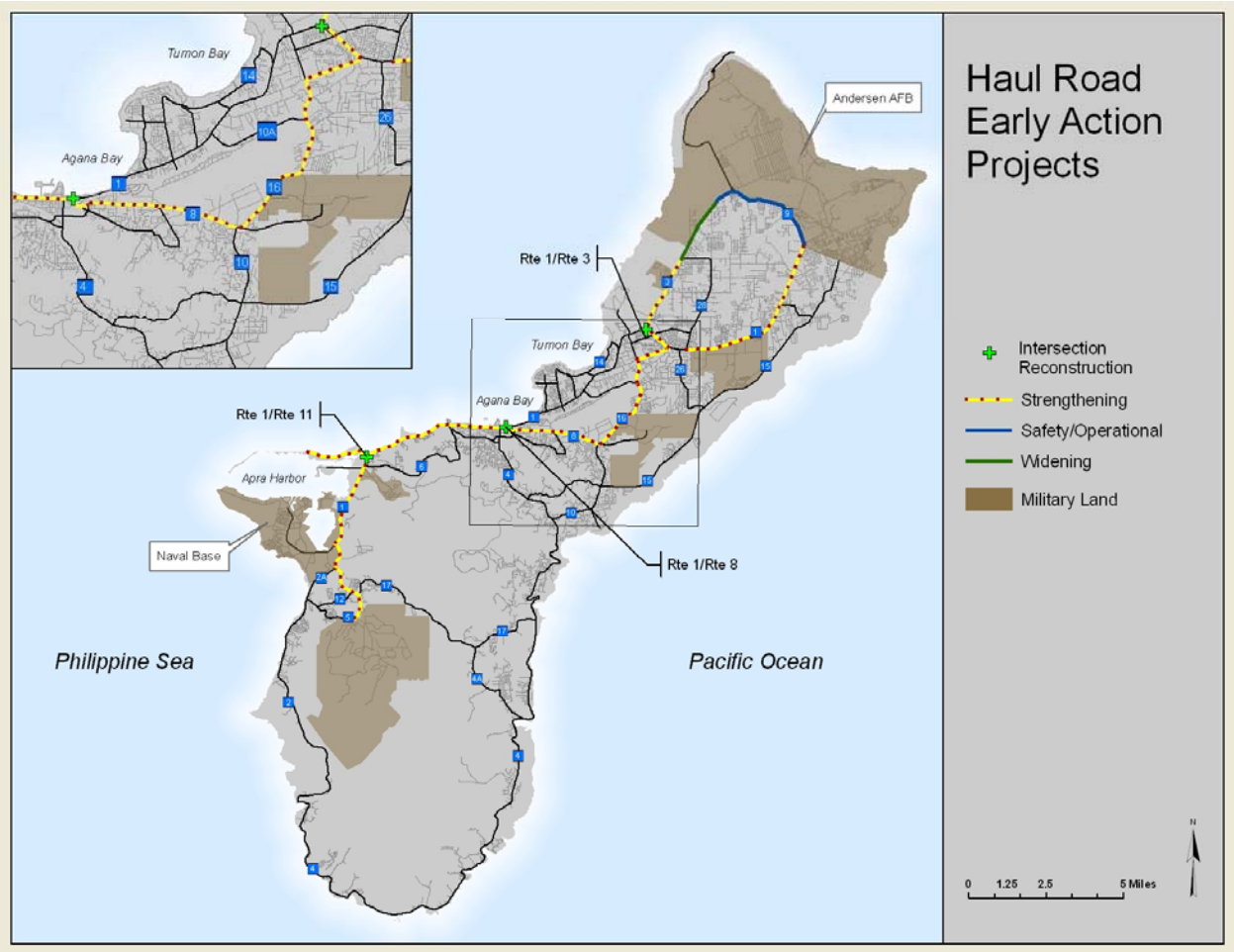
Figure 5-3 shows the early action roadway segments targeted for pavement reconstruction, intersection improvements, and bridge replacements in FY2010. The projects not identified as early action projects will be submitted for future funding.

Table 5-2: List of Haul Road Network Projects

Route	Segment Limits	Requirements/Comments
1	Route 1/Route 8	Intersection Improvements (.15 mile on Route 1 and .09 mile on Route 8)
1	Route 1/Route 3	Intersection Improvements (.24 mile on Route 1 and .04 mile on Route 3)
1	East of Route 4	Agana Bridge Replacement
1	Route 27 to Chalan Lujuna	Pavement strengthening (four lanes)
1	Route 3 to Route 27	Pavement strengthening (six lanes)
1	Route 11 to Asan River	Pavement strengthening (four lanes)
1	Asan River to Route 6	Pavement strengthening (four lanes)
1	Route 6 (Adelup) to Route 4	Pavement strengthening (six lanes)
1	Chalan Lujuna to Route 9 (AAFB)	Pavement strengthening (four lanes)
1	Route 11 to Route 2a	Pavement strengthening (four lanes)
1	Route 8 to Route 3	Pavement strengthening (six lanes)
3	Route 28 to Route 1	Pavement strengthening (four lanes)
3	NCTS Finegayan to Route 28	Pavement strengthening, widen from two lanes to four lanes, add and shoulders
3	NCTS Finegayan to Route 9	Pavement strengthening (two lanes), add median and shoulders
5	Route 2a to Route 17	Pavement strengthening (two lanes)
5	Route 17 to Naval Ordnance	Pavement strengthening (two lanes)
8	Tiyan Parkway/Biang Street to Route 1	Pavement strengthening (four lanes)
8	Route 10 to Tiyan Pkwy/Biang Street	Pavement strengthening (four lanes)
8	Route 16 to NAVCAMS Barrigada	Pavement strengthening (two lanes)
9	Route 3 to Route 1 (AAFB)	Pavement strengthening (two lanes), add median and shoulders
10	Route 15 to Routes 8 and 16	Pavement strengthening (four/six lanes)
10	Route 15 to Route 4	Pavement strengthening (four lanes)
11	Port to Intersection with Route 1	Rehabilitate two Lanes
11	Route 1/Route 11	Intersection improvements (.12 mile on Route 1)
15	Smith Quarry to Chalan Lujuna	Pavement strengthening (two lanes), safety/operational improvements
15	Route 10 to Connector (Chalan Lujuna end)	Pavement strengthening (two lanes)
16	Route 27 to Route 10a	Pavement strengthening (six lanes)
16	Route 10a to Sabana Barrigada Drive	Pavement strengthening (four lanes)
16	Sabana Barrigada Drive to Routes 8 and 10	Pavement strengthening (four lanes)
27	Route 1 to Route 16	Pavement strengthening (six lanes)
2a	Route 1 to Route 5	Pavement strengthening (four lanes)
Chalan Lujuna	Route 1 to Route 15	Pavement strengthening (2 lanes), Turning lane and intersection improvements for trucks

*Description of Proposed Action and Alternatives Data Sheets will not be in the ROADS section. These projects will be part of their respective master planned component.

Figure 5-3: Haul Road Network Early Action Projects



5.4 Performance Measures and Evaluation Criteria

The most important role of performance measures is to help GDPW make informed decisions about transportation projects to include in the GTP and to subsequently decide which GTP projects are included and funded in the TTIP. The performance measures are quantitative, value-neutral, and static and are used to measure transportation system performance at a given point in time. The performance measures have been developed for the following:

- Roadway system
- Roadway operations
- Intersections
- Bridges
- Pavement
- Safety
- Transit
- Bicycle and pedestrian

The performance measures are one method to help evaluate and prioritize proposed improvement projects. The measures represent a bridge between the goals of the GTP and objectives and the actions taken to improve the transportation system. They help serve as means to ascertain progress towards reaching a goal and objective. Performance measures were developed to utilize the best available data and to relate to the goals and objectives that were established for the GTP.

The measures outlined in this section also provide a way to measure the impact to Guam of the military build-up scheduled to begin in 2010. Specifically, the performance measures can be used to compare the existing traffic conditions on the island with expected future traffic conditions that will result from the military build-up.

The performance measures were also used to analyze the findings from the travel demand forecasting model to identify congestion-related deficiencies in the transportation network. Additional performance measures were developed to evaluate non-congestion-related transportation deficiencies, such as safety, maintenance, pavement, and bridge conditions; as well as freight movement, roadway access, pedestrian and bicycle use, and other transportation system components to determine and evaluate additional projects for inclusion in the GTP. Additional performance measures are designed to ensure that potential impacts to other types of public infrastructure are considered and to minimize potential impacts to low-income or minority populations.

5.4.1 Roadway System Level Performance Measures

System performance measures are designed to assess the overall condition of a transportation system. They include VMT and VHT. Total VHT was used to evaluate road system improvements. At the islandwide level, VHT is a good indicator to measure if a package of improvements helps increase travel speeds, which means less time is spent driving between origins and destinations. Guam's travel demand model was used to determine VHT under existing conditions as well as under projected future conditions, such as those imposed by the military build-up.

VMT is a direct measure of the demand for travel. VMT can be helpful in measuring the overall increase in the propensity for motorists to travel as a result of expanded growth and development. VMT also helps illustrate how travel behaviors change with investments in transit. On Guam, VMT is projected to increase substantially during the military build-up.

5.4.2 Roadway Operational Level Performance Measures

Operational level performance measures were designed to measure the components of the transportation system at a site-specific level. Site-specific locations refer to an arterial segment, an intersection, a pedestrian crossing, a transit stop, or other component of the transportation system. These measures typically include v/c ratio, travel delay in seconds, and average speed for a time period.

Capacity of a roadway refers to the amount of traffic that a particular road was designed to carry—how many vehicles can travel or "fit" on the road. If a road is over-capacity, more vehicles are using the road than it was designed for and traffic slows to unacceptable levels. In order to determine how well traffic will move, it is important to assess the current and future number (volume) of vehicles currently using or projected to

use a road compared to the capacity of vehicles that the roadway was designed to handle.

V/C ratios evaluate the number of vehicles that are forecast to travel over various Guam roads compared to capacity. Capacity is determined by the number of lanes, taking into account reduced capacity resulting from access points, such as driveways, intersecting roads, and other roadway elements. V/C ratios near or greater than 1.0 indicate congested conditions; the higher the ratio, the worse the traffic congestion.

For example, if a road can carry 1,000 vehicles, but there are currently 1,200 vehicles using the road, the v/c ratio is 1.2 (1,200 divided by 1,000)—indicating a congested road where traffic moves slowly. Ratios less than 1.0 indicate more acceptable traffic conditions where drivers can generally drive at or near posted speed limits, experience less interference from other drivers, and encounter fewer delays. Under congested conditions, the ability of drivers to maneuver becomes more limited leading to difficulties in changing lanes as well as entering and exiting the roadway. The v/c ratio can be evaluated on the basis of all-day traffic or peak-period traffic (busiest travel times, generally in the mornings from 7–9 a.m. and in the afternoons from 4–6 p.m.).

The v/c ratios allow scrutiny of the entire road network. V/C ratios are used to identify the more congested locations that can become higher-priority candidates for improvement projects. V/C ratios can also be employed to prioritize projects and direct resources toward projects that will address the more serious anticipated traffic congestion conditions. Additionally, this measure can be used to test the effectiveness of the proposed improvements through use of the travel demand model. Both v/c ratios and VHT were evaluated in this plan by using Guam's travel demand model.

A similar approach was employed to evaluate intersections for necessary improvements. A travel time analysis was performed using baseline traffic data (volumes and turning movements) collected as part of the Traffic Impact Study. The analysis determined the amount of time needed for a vehicle to pass though various intersections under present conditions. The current travel times through intersections were then compared with future travel times through intersections. Future conditions will be affected by increased traffic volumes resulting from the military build-up, as forecast using the travel demand model for the 2010–2014 and 2030 horizons. The travel times were examined to identify and prioritize future congested intersection locations and develop projects to improve their capacity.

5.4.3 Intersection Performance Measures

Intersections were analyzed and the results of this analysis are detailed in the Traffic Operations Improvement Plan. The performance measure used to determine recommended improvements was level of service (LOS) (Table 5-3). LOS for intersections is measured by the amount of delay (in seconds) that vehicles experience while trying to pass through an intersection. Those intersections with LOS E or F were recommended for improvement. Intersections were also assessed for safety based on crash ratings, which are detailed in the Safety and Hazard Elimination Study.

Table 5-3: Level-of-Service/Delay Thresholds for Signalized Intersections

Level of Service (LOS)	Delay (seconds/vehicle)
A	0–10 seconds
B	10.1–20 seconds
C	20.1–35 seconds
D	35.1–55 seconds
E	55.1–80 seconds
F	greater than 80 seconds

Source: Transportation Research Board, Highway Capacity Manual, 2000 Edition

5.4.4 Bridge Performance Measures

The GDPW maintains 36 bridges throughout the island. The bridges were inspected and rated on a scale of 1 to 5 ("structurally sound" to "needs replacement") for their structural integrity. Those bridges with a rating of 4 or 5, indicating that immediate attention is required, are programmed for replacement in the FY2008–2011 TTIP. Additionally, bridges were assessed in terms of future capacity needs, which were identified using the travel demand model.

5.4.5 Pavement Performance Measures

Pavement conditions were assessed based on a visual survey driving the roads of Guam. This measure is somewhat more qualitative than the rest of the performance measures. Performance indicators include presence of potholes and rutting or cracking in the pavement.

5.4.6 Safety Performance Measures

The Government of Guam collects a limited amount of data regarding vehicle crashes. Available data was examined to determine the ability to evaluate crash locations, frequency, and severity, which are typically used by states and municipalities to identify and prioritize locations for needed safety improvements. Additionally, crash data were compiled from accident records that, when scrutinized, enabled traffic and safety engineers to determine crash types (rear end, head on, sideswipe, angle, etc.) that can provide criteria for improvement measures.

Existing crash information was supplemented by interviews with local law enforcement officers who are generally assigned to respond to vehicular crashes and information from hospital emergency room personnel. A combination of available data and interview findings was used to determine locations along Guam's transportation system that are experiencing frequent severe crashes as well as to provide criteria for designing and prioritizing remedial safety projects for inclusion in the Guam Transportation Plan. This process was presented to the GDPW for comment, revision, and approval prior to application. Recommendations for additional data collection methods and programs were made as appropriate.

Roadway safety was evaluated based on the following measures:

- Number of crashes
- Type of crashes
- Severity of crashes
- Information provided by law enforcement officers

The Safety Improvement Program provides additional detail regarding safety issues.

5.4.7 Transit Performance Measures

The goal of improving accessibility, mobility and connectivity envisions the use of transit, bicycling, and walking as alternatives to vehicular travel. These alternative ways to travel can help offset some of the increased traffic that is anticipated as a result of the military build-up by providing a viable alternative to travel in private vehicles and improving mobility for non-drivers.

Limited existing transit ridership data is available. The GTP includes recommendations for transit improvements as well as provision of facilities to accommodate bicycles and pedestrians. A variety of analytical techniques were employed to support the preparation of transit improvement plans and to forecast their ridership effects.

Performance measures for transit improvement were developed to address operational efficiency of the transit system, probable effects on ridership, and measurable effects on traffic and travel as a result of diversion of travel by private automobile to transit. Operational efficiency was evaluated by the following measures:

- Vehicle revenue miles per vehicle revenue hour—this is the number of miles that buses travel when available to customers for each hour that they are available to customers.
- Vehicle revenue hours per total vehicle hours—this is the number of hours buses are in service and available to customers for each total hour it is operated from the time it pulls out of the garage to the time it pulls back in after revenue service.
- Vehicle hours per vehicle—this measures the utilization of each vehicle, indicating the length of time that the buses are in use.
- Vehicle miles per vehicle—this measures the miles a bus travels from the time it pulls out of the garage to the time it pulls back in.
- Average operating and maintenance (O&M) cost for each hour the buses are in use.
- Average O&M cost for each mile that the vehicle travels.

Ridership performance measures include the following:

- Passenger boardings, or the number of times customers get on a bus, including each boarding made if transfers are required to reach the customer's final destination
- Passenger linked trips, or the number of total journeys from origin to final destination
- Passenger miles carried

- Passenger boardings per vehicle mile
- Passenger boardings per vehicle hour

Performance measures addressing effects on traffic and travel will include the following:

- Change in the proportion of private automobile trips compared to transit, walking, and biking trips (mode split), especially during peak periods and in major travel corridors
- Transit user benefits (improvements in travel time and cost)
- Change in vehicular traffic, especially during peak periods and in major travel corridors

5.4.8 Bicycle and Pedestrian Performance Measures

Selection of proposed improvements considered the level of safety, access, and mobility provided for walking and bicycling. This included observations of the following elements:

- Potential impacts to the islandwide system of bicycle lanes, routes, trails, or sidewalks
- Safety of pedestrian crossings
- Non-motorized access to commercial or employment centers and other key destinations

5.4.9 Performance Measures and Continued Transportation Planning

The use of performance measures to identify a program of projects for the GTP is not a one-time action. An established on-going transportation planning process will need to be carried out on a continued basis. The process should involve government officials, stakeholders (such as the military), and the public in a dialogue on future transportation infrastructure. Using this information, decisions will build upon themselves to provide a sustainable transportation system for Guam. The planning process can use the identified performance measures to monitor future conditions to determine the effectiveness of the improvements, identify emerging needs, and provide a basis for effective use of future transportation funding. This will require data collection, analysis, and the continued use of models such as TransCAD, DyanaSMART, and other Highway Capacity Manual related programs.

5.4.10 Evaluation Criteria

In addition to the quantitative performance measures, more qualitative evaluation criteria were also developed as a means to assess the recommended improvements. These criteria incorporate aspects of the GTP's goals and objectives and reflect community-based values, as expressed by the leaders and citizens of Guam.

Table 5-4 shows the evaluation criteria that were developed in coordination with GDPW. The criteria are listed from top to bottom in terms of relative importance and a weighting factor has been assigned to each on a scale of 1 to 5. Within each criterion are three

Table 5-4: Guam Transportation Plan Project Evaluation Criteria (2030)

Priority	Criteria	Highest Importance (x3)	Medium Importance (x2)	Important (x1)	Not Applicable (x0)	Related GTP Goals
5	Public health and safety	Project needed to alleviate existing health or safety hazard	Project needed to alleviate potential health or safety hazard	Project promotes or maintains health or safety	No health or safety benefit associated with project	2, 5, 11
4	Protection of capital stock	Project is critical to save structural integrity of existing facility or repair significant structural deterioration	Project will repair systems important to facility operation	Project will improve facility appearance or deter future expenditure	No existing facility involved	3, 4, 10
3	Traffic congestion	Project needed to alleviate existing severe congestion problem	Project needed to alleviate future severe congestion problem	Project needed to alleviate future moderate congestion problem	No existing or future congestion problems are anticipated	3, 4
3	External requirements	Project is required by law, regulation, court mandate, or agreement with other jurisdictions	Project will be conducted in conjunction with another jurisdiction (with committed funding)	Project will be conducted in conjunction with another jurisdiction (with no committed funding)	Project is Guam only and not externally required	9
3	Economic development	Project will have a direct impact through encouraged capital investment, improved tax base, improved job opportunities, or attraction of consumers	Project will have an indirect economic impact	Project may have an indirect economic impact	Project will have no significant economic development impact	3, 4, 6
3	Availability of additional funding	All or part of funding is provided by non-Guam revenues	Non-Guam revenues have been identified and applied for	Potential for non-Guam revenues exists	No non-Guam revenues are available	8
2	Population served	Federal road functions as major arterial	Federal road functions as minor arterial	Federal road functions as a collector/local road	Other road	1
2	Relation to adopted plans	Project is included in Guam Transportation Plan		Project is included in written plans of staff (corridor/safety studies)	Project is not included in any written plans	1, 5, 6
1	Timeliness	Undertaking the project will allow Guam to take advantage of a favorable current situation			External influences do not affect the timeliness of this project	8

levels of importance, which are shown from left to right across the table. The total score for projects is determined by multiplying the weighting factor by the level of importance and then adding the scores for each criterion. In order to show how the plan's goals relate to each evaluation criteria, a column has been added with the number of each related goal. The full discussion of goals and objectives is found in Chapter 2.

The nine evaluation categories and their respective weighting factors are described below.

5.4.10.1 Public Health and Safety (5)

This category addresses the safety aspect of the roadways. Roads that have a weighted crash rate higher than 15.0 score the most points; crash rates of higher than 7.5 receive the second highest points. Intersections that were identified in the safety improvement program also receive the highest number of points in this category. Other types of projects are scored based on the safety record of the road.

5.4.10.2 Protection of Capital Stock (4)

This is the highest weighting category related to functional improvements of the existing system. In these cases, roads with the worst pavement condition and the worst rated bridges score the highest. Roads that are in reasonable condition and bridges that are expected to last beyond the 2030 time frame score fewer points. It should be noted that road condition was measured subjectively based on window surveys and general knowledge.

5.4.10.3 Traffic Congestion (3)

This category addresses road or intersection congestion. Projects along roads with existing severe congestion are ranked highest, expected future congestion next, and expected future moderate congestions after that. Roadway segments and intersections that currently operate at the lowest LOS, F, get the most points. Other types of projects receive congestion points based on the road that they are part of.

5.4.10.4 External Requirements (3)

These types of projects get points if required by an agreement between GDPW and others. Although this is an important criterion, it is not likely to apply to many projects. Tijan Parkway may be the one current example, as this project is to be completed within five years per a written agreement.

5.4.10.5 Economic Development (3)

A recommended project would receive points if it will stimulate economic growth. Projects that were awarded points include Tijan Parkway, which involves an airport related development; the proposed Finegayan connection as it would provide improved access to the Dos Amantes Planning Area; and any new connections as they may help spur residential development.

5.4.10.6 Additional Funding (3)

All projects shown in the GTP get the maximum points as they are all funded by non-Guam (FHWA) funds. The idea is that other funding (non-Guam) availability may present itself and could be incorporated into the scoring criteria. Other funding sources may be other federal programs (other than FHWA, FTA, or USDOD), insurance company safety grants, private funds, etc.

5.4.10.7 Population Served (2)

This criterion is proposed to spend available funds on roads that benefit the most users. Roads that function as major arterials score the most points, while local residential streets score the least.

5.4.10.8 Relation to Adopted Plans (2)

This criteria gives the maximum number of points to projects identified in the GTP. It has been added to assist in the evaluation of future, proposed, projects so that weight can be given to those currently proposed in the plan.

5.4.10.9 Other Considerations (2)

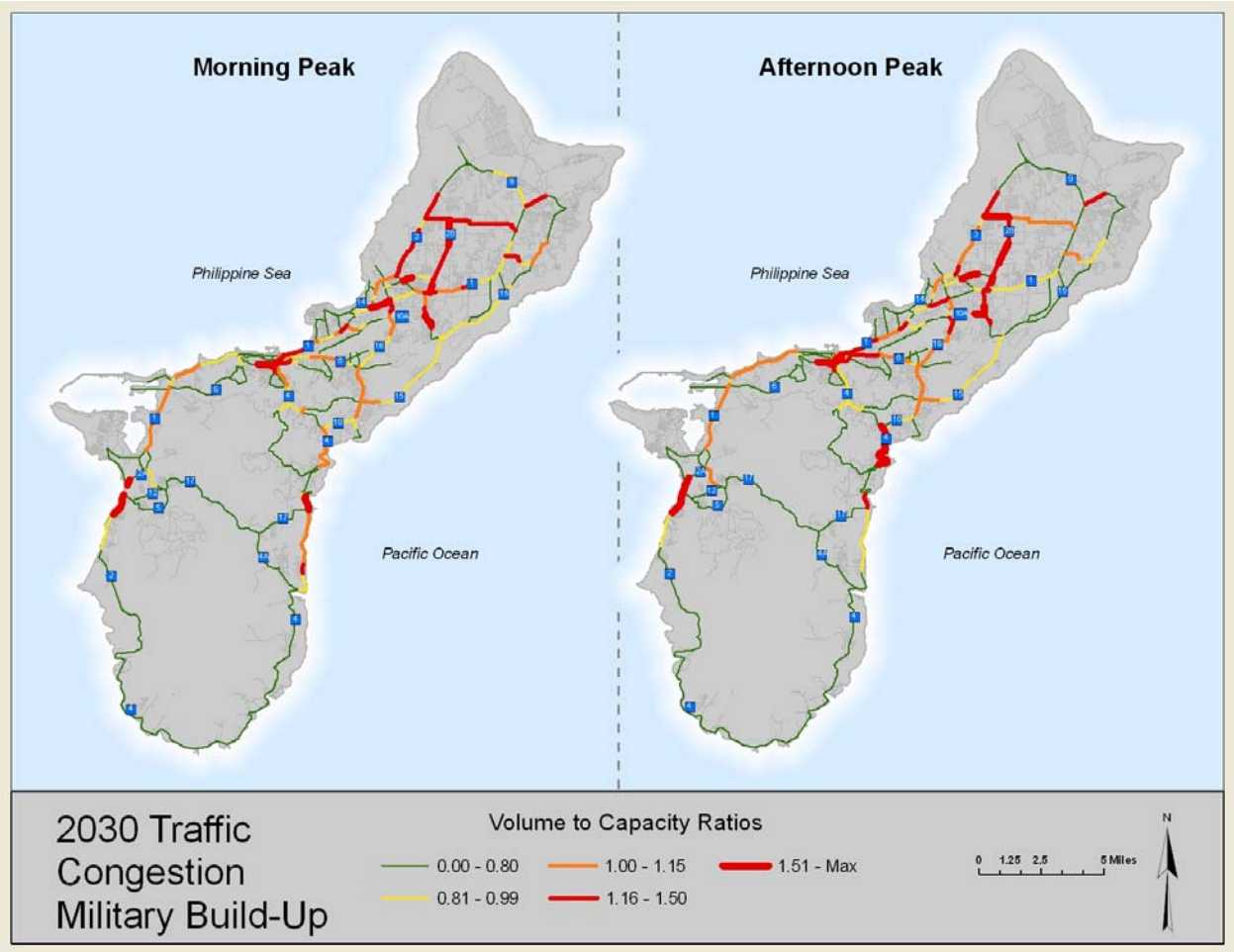
This is a proposed criterion that indicates a project should be completed given a favorable situation presented by outside forces. An example of this may be a public/private partnership to address a need along a specific roadway in which a party is willing to cost share in a project important to Guam.

5.5 Improvement Projects

5.5.1 Tier I Congestion-Related Projects

Tier I congestion-related projects were identified to address the most severely congested roadways that will be affected by normal growth on Guam as well as the anticipated military build-up. Many of these roads are congested today, and congestion levels will continue to worsen in 2030. Roads that are projected to be severely congested are highlighted in red in Figure 5-4 and are expected to have peak hour v/c ratios greater than 1.15.

Figure 5-4: Congestion Levels (2030)



These capacity projects include road widenings and safety/operational improvements that would incrementally increase the capacity of the road system. The road widening projects included additional through lanes. The safety/operational improvements are recommended on road segments that would benefit from an incremental increase in capacity, but do not require full lane widening. Safety/operational improvements include turn lanes raised medians for access control, and/or shoulders/sidewalks.

The Tier I congestion-related projects are shown in Figure 5-5 and listed in Table 5-5. The Route 10a widening projects that are considered "committed" are shown for information purposes. The resulting congestion levels that can be expected in 2030 with implementation of Tier I improvement projects are shown in Figure 5-6. As noted in Figure 5-6, many roads on-island will remain congested and these will be addressed with Tier II projects.

Figure 5-5: Tier I Roadway Improvements

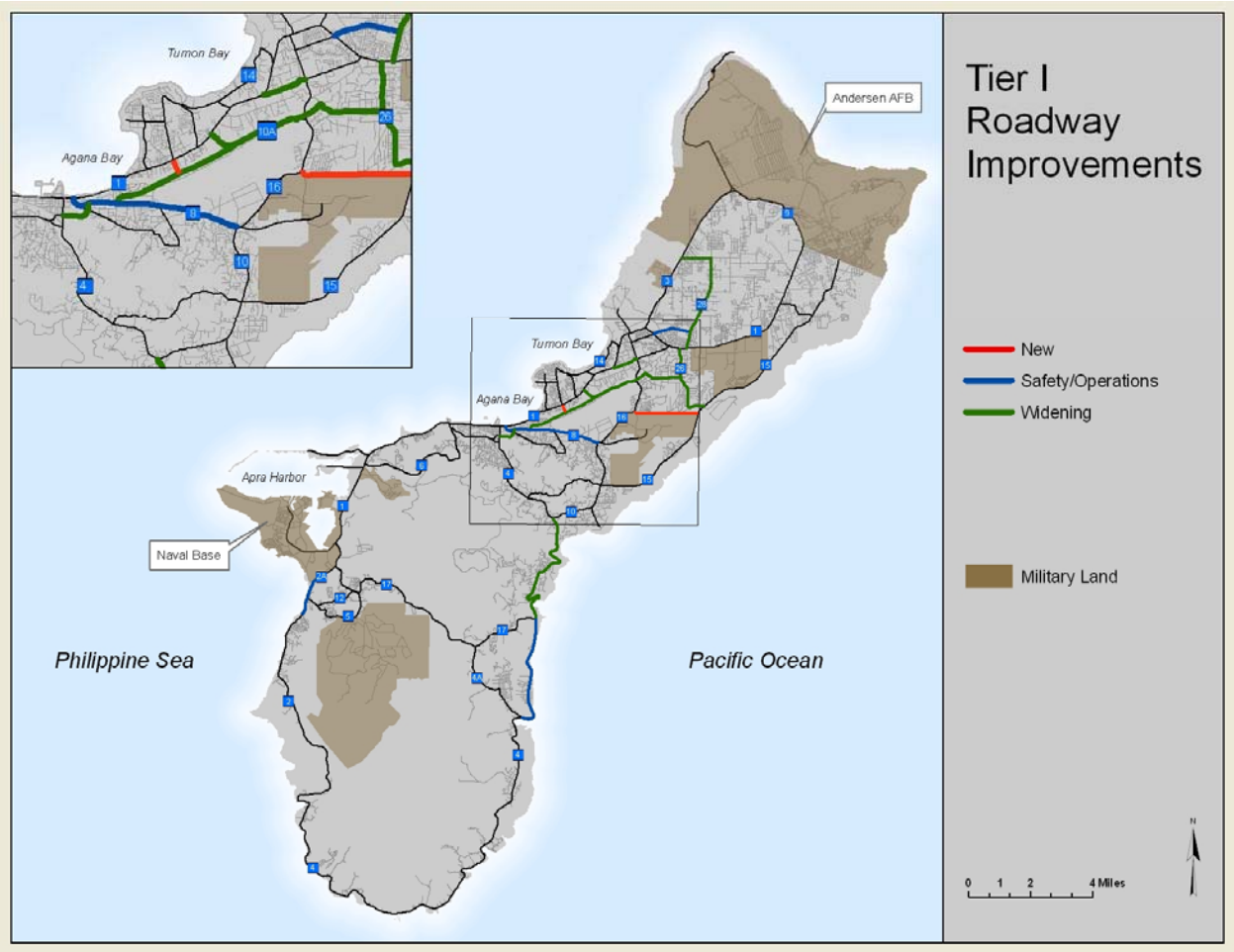
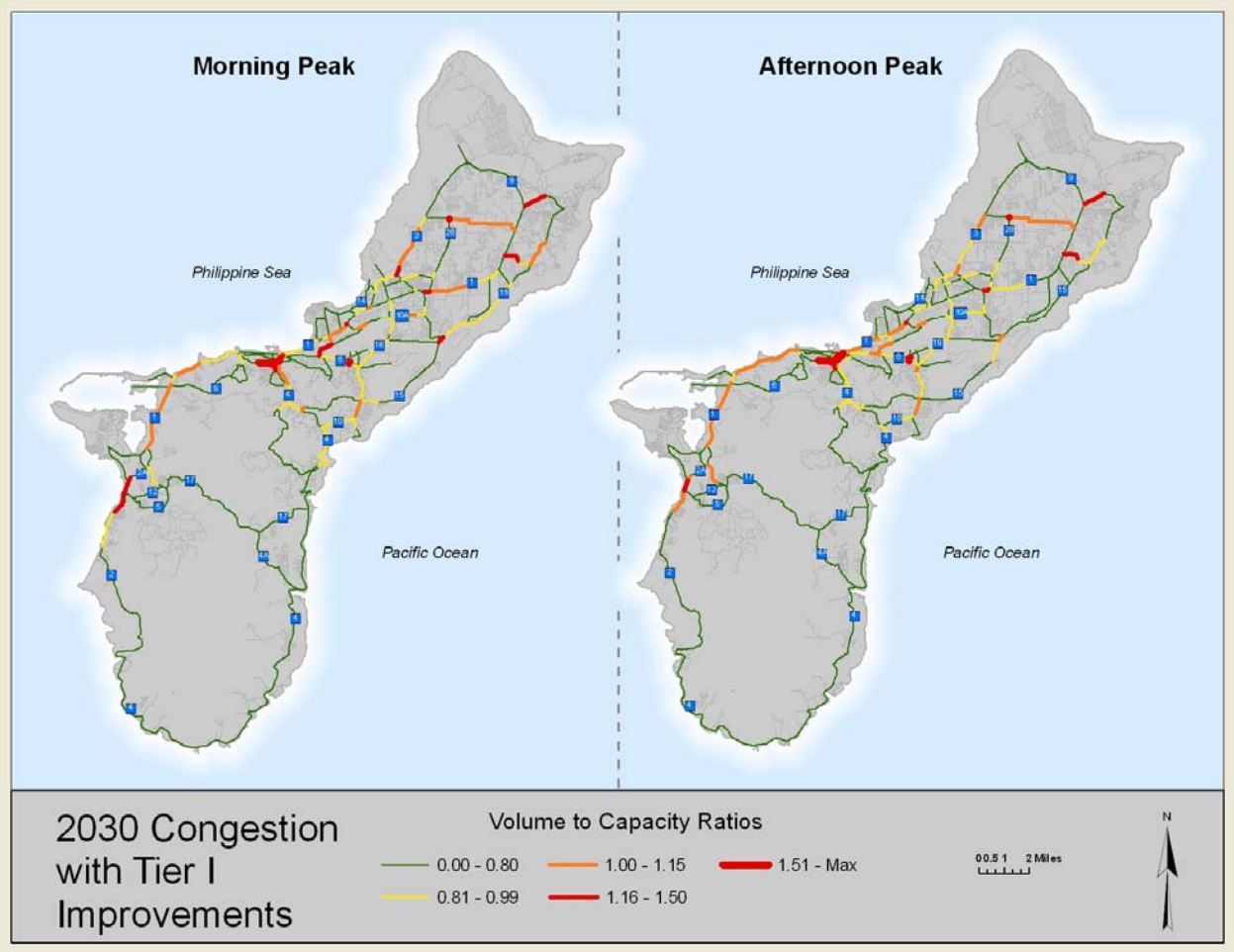


Table 5-5: Tier I Roadway Improvements

Project Name	Project Limits	Project Description	Length (miles)	2008 Volume (vpd)	Peak Hour Congestion*		Safety		
					2008	2030	Fatals	Injury	Rate**
Tijan Parkway	Route 10a to Route 8	Widen from two to four lanes/ sidewalks	2.65	13,700	N	M	0	24	4.53
Route 14 Extension	Route 1 to Tiyan Parkway	New four-lane connection	0.60	NA	M	M	NA	NA	NA
Route 28	Route 3 to Route 1	Widen from two to four lanes/ sidewalks	3.90	12,500	M	S	1	93	13.4
Route 8	Route 1 to Route 10	Safety/operational improvements	3.14	37,700	N	M	3	155	9.38
Route 4	Route 10 to Route 17	Widen from two to four lanes/ sidewalks	2.70	18,300	M	S	1	82	11.7
Route 4	Route 17 to Route 4a	Safety/operational improvements	5.80	8,100	N	M	1	40	6.18
Route 2	Route 2a to Erskin Dr	Safety/operational improvements	1.16	17,300	S	S	2	44	16.7
Route 27 Ext (Hamburger Highway)	Route 16 to Route 1	Widen from two to four lanes/ sidewalks	0.80	13,800	M	S	NA	NA	NA
Route 27a	Route 1 to Route 28	Safety/operational improvements	1.20	9,500	S	S	0	8	4.81
Route 25	Route 16 to Route 26	Widen from two to four lanes/ sidewalks	1.40	15,600	S	S	0	24	7.53
Route 26	Route 1 to Route 15	Widen from two to four lanes/ sidewalks	2.54	14,000	N	S	0	119	22.9
Adacao Connection	Route 16 to Route 15	New two-lane connection/turn lane/shoulders	2.06	NA	M	M	NA	NA	NA
Route 7a	Route 8 to Route 4	Widen from three to four lanes	0.60	15,000	N	S	0	20	15.2

NA = Not Applicable
*S = Severe, M = Moderate, N = None, NA= Not Available
**Rate = weighted number of crashes per million miles of travel

Figure 5-6: Congestion Levels after Tier I Improvements



5.5.2 Tier II Congestion-Related Improvements

After the Tier I improvements were developed to address the most severely congested roads, a second list of Tier II congestion-related improvement projects was generated to address roads that will remain congested in 2030. These projects mitigated the congestion on the remainder of the severely congested roads (shown in red in Figure 5-6) and the majority of the moderately congested roads (shown in orange in Figure 5-6). The v/c ratio associated with the moderately congested roads was between 1.00 and 1.15, meaning that they were up to 15 percent over the expected capacity. Table 5-6 shows the additional congestion-related improvements.

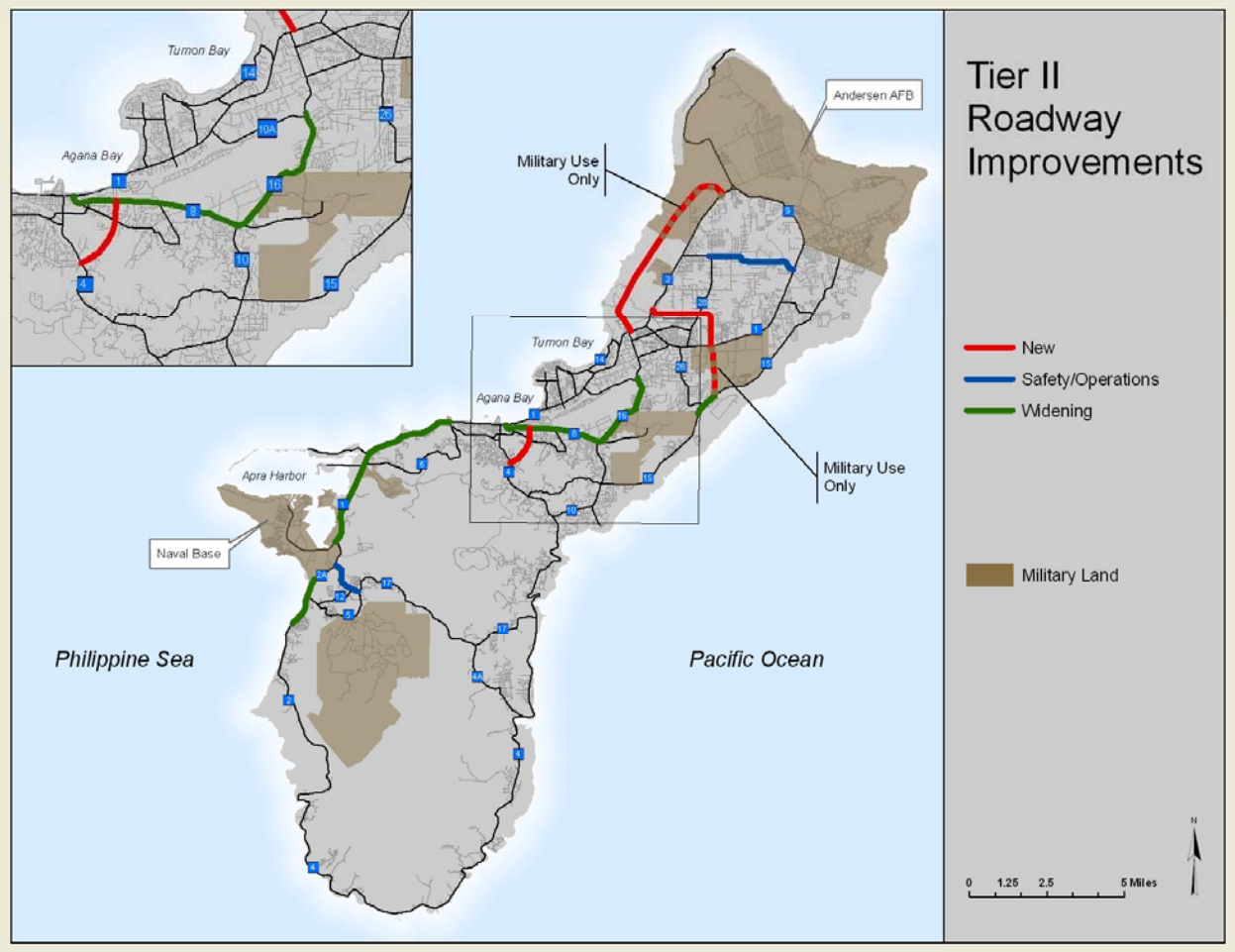
Table 5-6: Tier II Congestion-Related Improvements

Project Name	Project Limits	Project Description	Length (miles)	2008 Volume (vpd)	Peak Hour Congestion*		Safety		
					2008	2030	Fatals	Injury	Rate**
Route 8	Route 1 to Route 10	Widen from four/six to six lanes	3.14	37,700	N	M	3	155	9.38
Route 16	Route 10a to Route 10	Widen from four to six lanes	2.65	37,300	N	M	3	124	9.09
Finegayan Connection	Route 1 to Route 3	New two-lane connection/turn lane/ shoulders	2.51	N/A	N	M	N/A	N/A	N/A
Okkodo Connection	Finegayan to Route 28	New two-lane connection/shoulders	2.29	N/A	N	M	N/A	N/A	N/A
Okkodo Connection	Route 28 to Route 1	New two-lane connection/turn lane/ sidewalk	1.42	N/A	N	M	N/A	N/A	N/A
MogFog Connection	Route 1 to Route 15	New two-lane connection/turn lane/ shoulders	1.64	N/A	N	M	N/A	N/A	N/A
Koda/Nijok/Mataguac	Route 28 to Route 1	Safety/operational improvements	2.93	2,300	N	S	N/A	N/A	N/A
Ordot-Mongmong Connection	Route 8 to Route 4	New two-lane connection/turn lane/ shoulders	1.49	N/A	N	M	N/A	N/A	N/A
Route 5	Route 2a to Route 17	Safety/operational improvements	1.26	11,800	N	M	0	22	10.1
Route 2	Route 2a to Erskin Dr	Widen from two to four lanes/ shoulders	1.28	17,300	S	S	2	44	15.1
Route 1	Route 6 (Adelup) to Route 11	Widen from four to six lanes	2.90	35,900	N	M	2	46	3.34
Route 1	Route 11 to Route 2a	Widen from four to six lanes	3.10	31,100	N	M	1	63	4.65
Route 15	Adacao to MogFog	Widen from two to four lanes/ shoulders	0.72	15,100	N	M	0	17	10.7

NA = Not Applicable
*S = Severe, M = Moderate, N = None
**Rate = weighted number of crashes per million miles of travel

As with the Tier I improvements, these capacity projects include road widenings and safety/operational improvements that would incrementally increase the capacity of the road system (Figure 5-7). The road widening projects included additional through lanes. The safety/operational improvements are recommended on road segments that would benefit from an incremental increase in capacity but do not require full lane widening. Safety/operational improvements include turn lanes, raised medians for access control, and/or shoulders/sidewalks.

Figure 5-7: Tier II Roadway Improvements



5.5.3 Impact on Traffic Congestion—Tier I and Tier II Congestion-Related Improvements

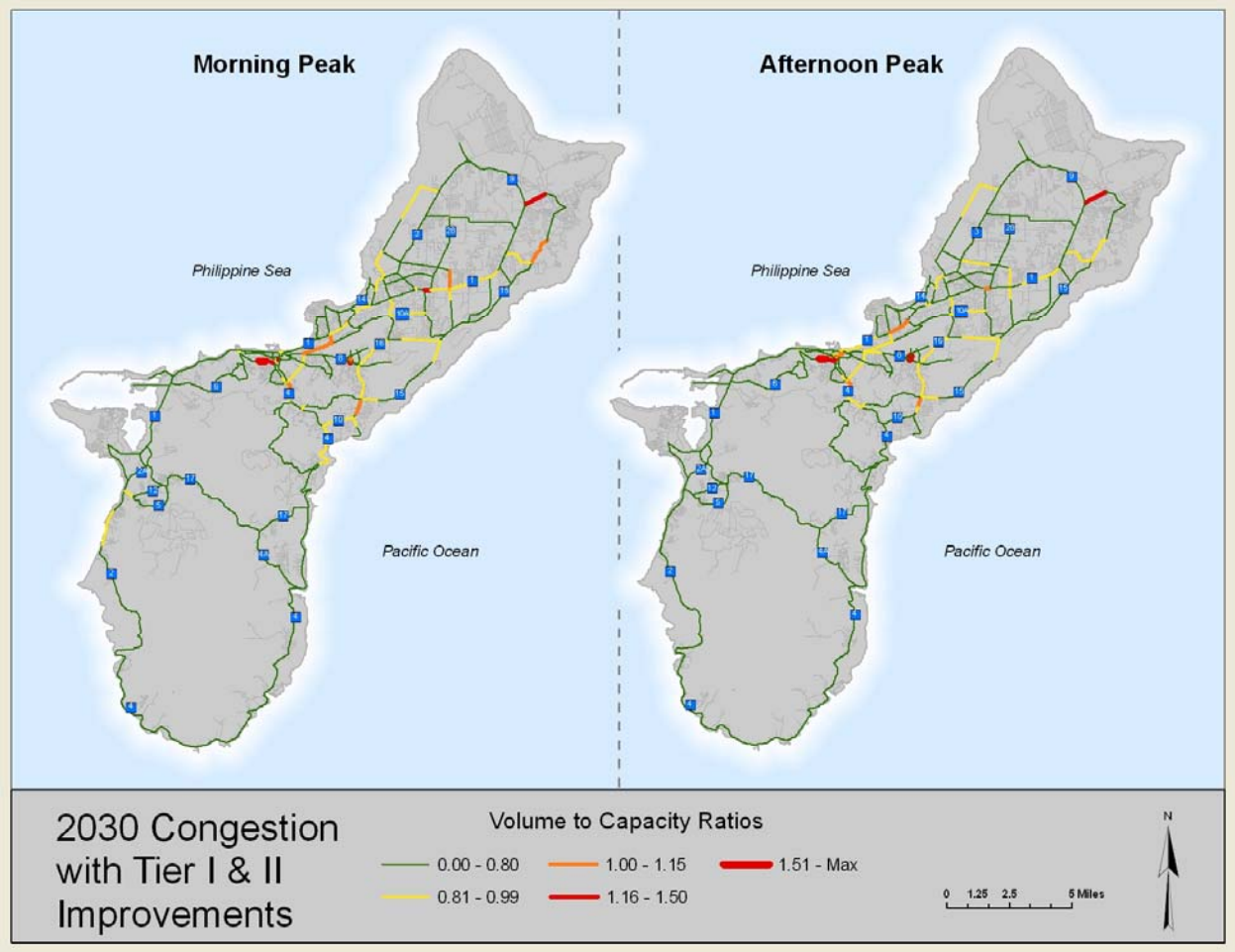
As discussed previously, the use of operational level performance measures was one method to measure the impact of the transportation improvements on a specific segment of roadway. Table 5-7 shows road performance (v/c ratios) in 2030 both with and without the proposed improvements. Figure 5-8 shows the congestion levels in 2030 after the Tier I and Tier II congestion-related improvements were added to the travel demand

model. With the improvements, the number and severity of congested roads is significantly reduced.

Table 5-7: Roadway Performance with and without Improvements (2030)

Year	Vehicle Hours Traveled	Vehicle Miles Traveled
2008	75,200	2,209,500
2030 no improvements	138,400	3,751,400
2030 improvements	133,900	3,720,000

Figure 5-8: Congestion Levels after Tier I and Tier II Improvements



In addition to the operational level performance measures discussed above, system level performance measures were used to assess the overall condition of the transportation network. These measures included VHT and VMT.

As shown in Table 5-7, the modeling results indicate that there will be an increase in VHT and VMT in 2030 associated with the increased traffic on Guam. However, both measures decrease with the implementation of the proposed improvements. While the overall level of improvement is modest, there will be significant localized benefit in the identified project areas.

Figure 5-8 provides additional detail regarding the impacts of the needed improvements on the transportation system. Using system level performance measures, the 2030 E+C road network was compared with the full mitigation network, which incorporates all Tier I and Tier II projects to determine the level of effectivenss of the improvements. The results are shown in Table 5-8.

All of the measures are improved by the identified projects, though the greatest difference is seen in the levels of delay. For each of the morning and afternoon peak travel times, off-peak travel times, and day-long traffic, delay is significantly improved by 40 to 56 percent.

Table 5-8: Effectiveness of High Priority and Priority Improvements

Measure of Effectiveness	2030 Full Population E+C Network	2030 Full Population Mitigation Network	Percent Difference
Morning Peak Hour			
Vehicle Miles	355,256	349,691	-1.6%
Vehicle Hours	14,955	12,942	-13.5%
Delay (hours)	3,043	1,328	-56.4%
Speed (mph)	24	27	12.5%
Afternoon Peak Hour			
Vehicle Miles	382,087	377,200	-1.3%
Vehicle Hours	15,891	13,943	-12.3%
Delay (hours)	3,038	1,385	-54.4%
Speed (mph)	24	27	12.5%
Off-Peak Hours			
Vehicle Miles	251,173	248,914	-0.9%
Vehicle Hours	8,959	8,585	-4.2%
Delay (hours)	530	322	-39.2%
Speed (mph)	28	29	
Daily Totals			
Vehicle Miles	4,488,762	4,440,744	-1.1%
Vehicle Hours	169,197	156,785	-7.3%
Delay (hours)	18,518	9,290	-49.8%
Speed (mph)	27	28	3.7%

5.5.4 Rehabilitation Improvements

Rehabilitation or reconstruction improvements are needed to address the remainder of Guam's federal-aid road network that will not be widened as part of the Tier I or Tier II capacity improvement projects, nor will they be addressed by the improvements in the Haul Road program. These improvements typically include milling and overlaying

existing roads to improve the paved surface and replacement of damaged concrete sidewalks, curbs, and gutters. Rehabilitation projects may also include minor safety enhancements and sidewalk improvements to meet minimum ADA standards. Upgrades to signage and pavement markings would also be included. Figure 5-9 and Table 5-9 show the needed rehabilitation improvements.

Figure 5-9: Rehabilitation Projects

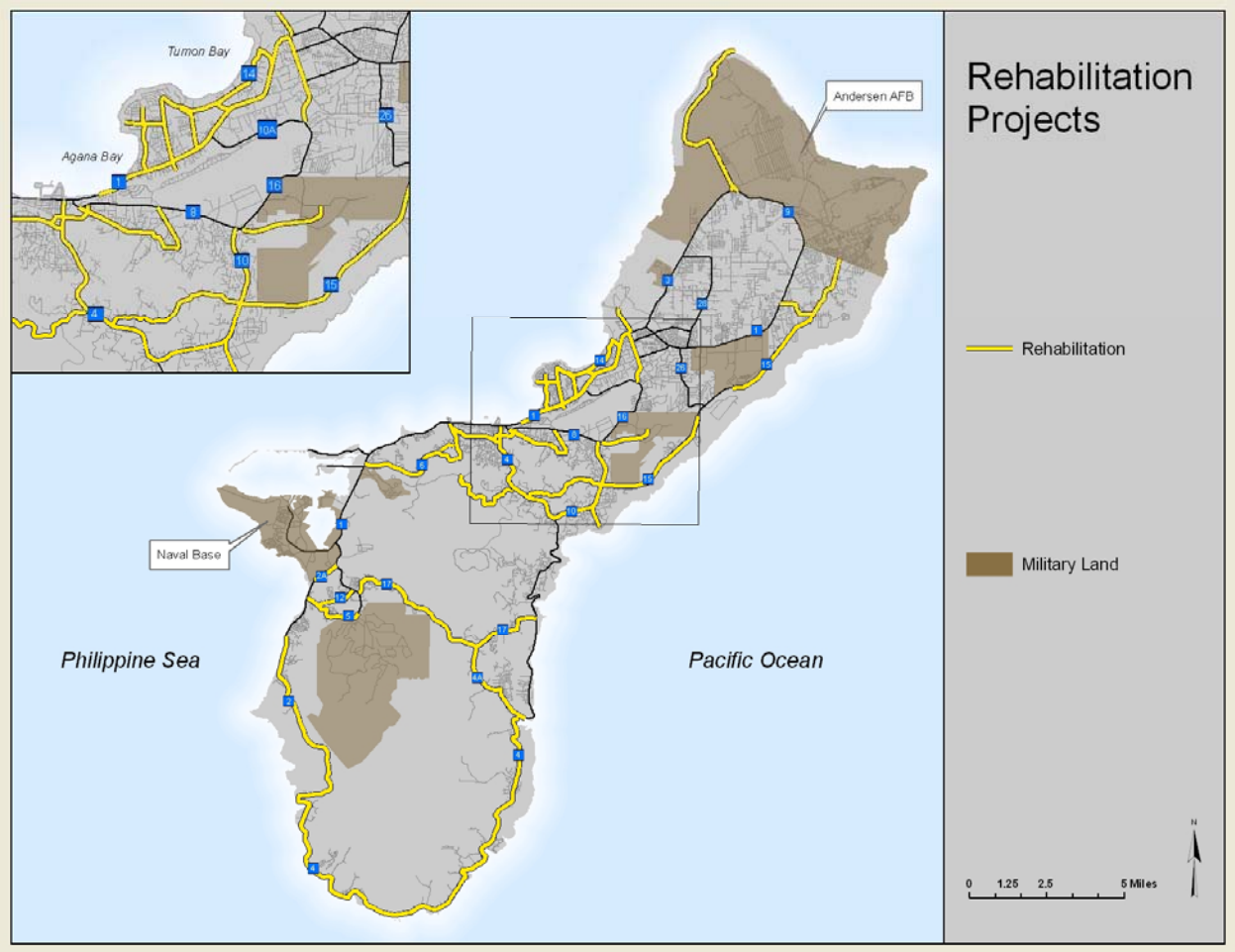


Table 5-9: Rehabilitation Improvements (Reconstruction)

Project Name	Project Limits	Project Description	Length (miles)	2008 Volume	Peak Hour Congestion*		Safety		
					2008	2030	Fatal Accidents	Injury	Rate
Route 1	Route 3 to Route 8	Rehabilitate six lanes	5.93	67,500	S	M	7	1100	19.1
Route 3a	Route 3 to End	Rehabilitate two lanes/shoulders	6.10	100	N	N	0	1	11.2
Route 34	Route 1 to Two Lovers Point	Rehabilitate two lanes/shoulders	3.60	1,000	N	N	0	5	9.51
Route 29	Route 1 to Route 15	Rehabilitate two lanes/shoulders	1.20	8,200	M	M	0	33	23
Route 15	AAFB to Route 10	Rehabilitate two lanes/shoulders	11.41	8,500	N	N	2	97	7.19
Route 15 (Dairy)	Route 4 to Route 10	Rehabilitate two lanes/shoulders	2.79	1,000	N	N	1	14	40.3
Route 16	Route 1 to Route 27	Rehabilitate four lanes	3.90	24,000	N	M	1	174	12.9
Route 14	Route 1 to Route 1 (ITC)	Rehabilitate four lanes	3.90	18,500	N	N	4	525	50.8
Route 14a	Route 14 to Route 1	Rehabilitate two lanes	0.20	18,200	N	N	0	23	43.3
Route 14b	Route 14 to Route 1	Rehabilitate two lanes/sidewalks	0.80	4,300	N	N		24	47.8
Route 30	Route 1 to End	Rehabilitate two lanes/sidewalks	1.30	16,300	N	N	0	32	10.3
Route 30a	Route 14 to End	Rehabilitate four lanes	0.60	13,800	N	N	0	27	22.3
Route 8	Route 16 to End	Rehabilitate two lanes/shoulders	1.16	1,400	N	N	0	6	25.3
Route 32	Route 10 to End	Rehabilitate two lanes	0.60	3,600	N	N	2	10	46.9
Route 33	Route 8 to Route 8	Rehabilitate two lanes/sidewalks	2.20	3,300	N	N	0	4	3.77
Route 10	Route 8 to Route 4	Rehabilitate four lanes	3.20	31,000	N	M	4	212	15.3
Route 6	Route 1 (Adelup) to Overlook	Rehabilitate two lanes/sidewalks	2.08	4,700	N	N	2	18	16
Route 6	Overlook to Route 1	Rehabilitate four lanes/shoulders	2.72	2,600	N	N	0	11	10.7
Route 6a	Route 6 to Route 6	Rehabilitate two lanes/sidewalks	0.80	NA	N	N	0	0	NA
Route 7	Route 24A to Route 6	Rehabilitate two lanes	1.60	12,100	N	M	0	24	8.49
Route 7a	Route 4 to Route 24a	Rehabilitate two lanes/sidewalks	2.20	600	N	N	0	11	57.1
Route 7b (Nelson)	Route 4 to Route 7	Rehabilitate two lanes/sidewalks	0.20	7,500	N	N	0	9	41.1
Route 24	Route 7a to Route 24	Rehabilitate two lanes	1.00	900	N	N	NA	NA	NA
Route 24a (Pale Kieran Hickey)	Route 7a to Route 24	Rehabilitate two lanes/shoulders	0.90	10,000	N	M	0	5	3.81
Route 17	Route 5 to Route 4	Rehabilitate two lanes/shoulders	7.40	4,300	N	N	1	49	11.1
Route 4	Route 1 to Route 10	Rehabilitate four lanes/sidewalks	3.99	25,000	N	M	3	341	23.9
Route 4	Route 2 to Route 4a	Rehabilitate two lanes/shoulders	9.31	2,300	N	N	1	69	22.8
Route 4a	Route 17 to Route 4	Rehabilitate two lanes/shoulders	2.40	3,700	N	N	1	11	10.3
Route 2	Route 4 to Erskin Drive	Rehabilitate two lanes/shoulders	8.74	3,800	N	N	0	34	7.01
Route 2a	Route 5 to Route 2	Rehabilitate four lanes/shoulders	1.80	16,200	N	N	2	33	8.88
Route 12	Naval Ordnance to Route 2	Rehabilitate two lanes/shoulders	2.70	3,000	N	N	0	16	13.5
Route 12a	Route 5 to Route 12	Rehabilitate two lanes/sidewalks	1.50	1,300	N	N	0	0	0
Route 19 (Dero)	Route 4 to Land Fill	Rehabilitate two lanes/shoulders	2.30	9,300	N	N	0	0	0
Route 40 (Aspinal)	Route 1 to Route 7a	Rehabilitate two lanes	0.20	3,900	N	N	0	0	0
Route 41 (5th Street)	Route 1 to Route 7a	Rehabilitate two lanes	0.20	100	N	N	0	0	0

NA = Not Applicable
*S = Severe, M = Moderate, N = None

5.5.5 Intersection Improvements

The list of intersection projects was developed to address existing peak hour congestion and safety problems. Intersections that currently operate at LOS E or F as identified in the Traffic Operations Improvement Plan were considered for inclusion. If the congestion could not be improved by signal timing adjustments, and the intersection was not planned to be improved as part of a Tier I capacity improvement project, the intersection was added to the list of improvements. Figure 5-10 shows intersection project locations.

Additionally, intersections that had 30 or more crashes in 2005 and 2006, as identified in the Safety and Hazard Elimination Study, were included in the intersection list, Table 5-10. This list represents the 18 intersections with the highest number of crashes. An additional location, Route 10/Route 15, was added to the list because three fatal crashes occurred during the two-year period.

Figure 5-10: Intersection Improvements

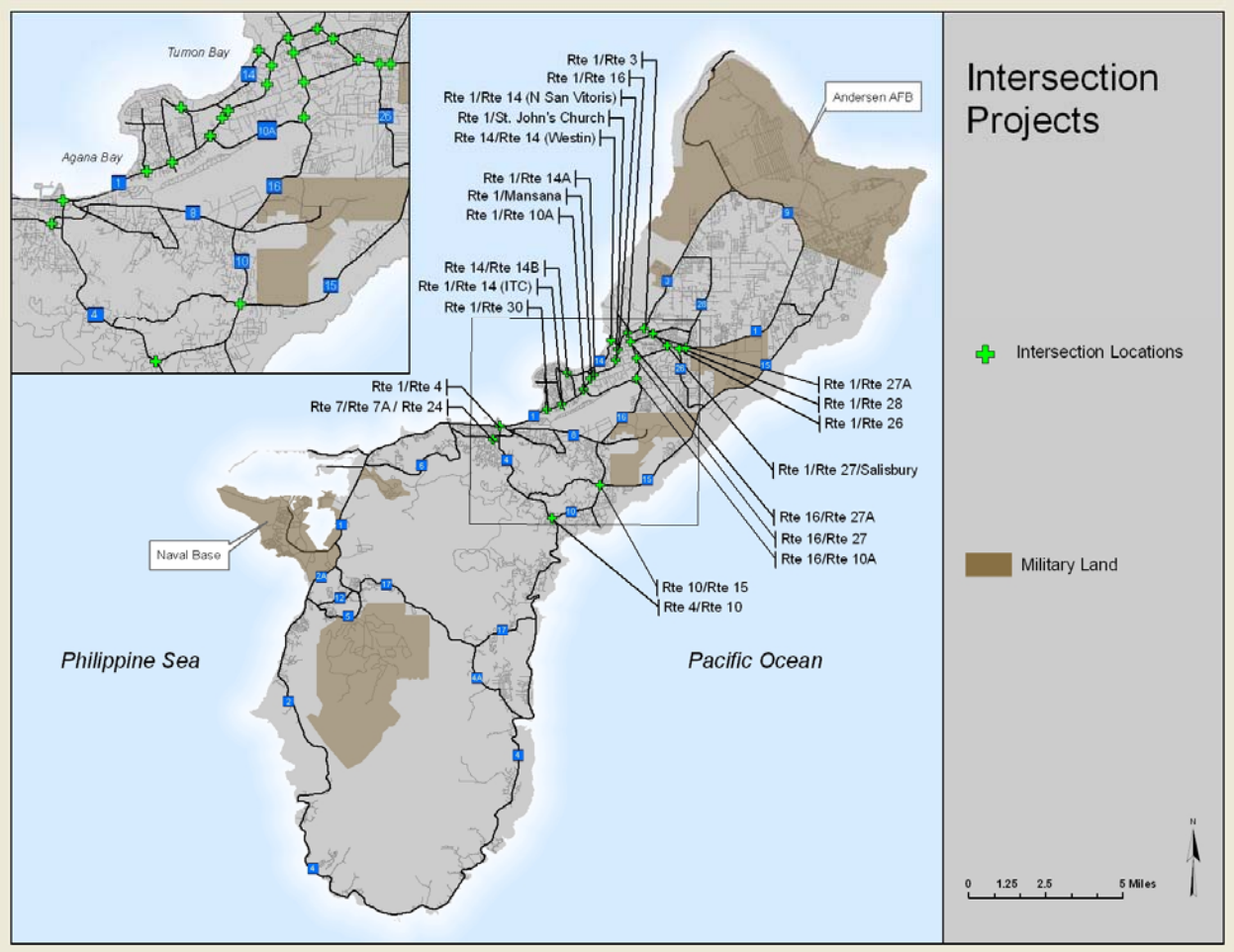


Table 5-10: Intersection Projects

Project Name/Intersection	Project Description	Peak Hour Congestion 2008	Identified Safety Problem*
Route 1/Route 28	Traffic signal modifications, signing, striping	No	X
Route 1/Route 26	Traffic signal modifications, sign/stripe and median	No	X
Route 1/Route 27/Salisbury	Additional southbound left turn lane	Yes	X
Route 1/Route 27a	Eastbound right-turn lane	Yes	X
Route 1/Route 3	Additional northbound left-turn lane	Yes	X
Route 1/Route 16	Traffic signal modifications, signing, striping	No	X
Route 1/Route 14 (N San Vitoris)	Additional northbound left-turn lane	Yes	
Route 1/Route 14a	NB/SB right-turn lanes	Yes	X
Route 1/St. John's Church	Minor street approach widening	Yes	
Route 1/Mansana	Signing, striping	No	X
Route 1/Route 10a	Northbound right-turn lane	Yes	X
Route 1/Route 14 (ITC)	Additional turn lanes and development access	Yes	X
Route 1/Route 30	Additional turn lanes	Yes	X
Route 1/Route 4	Southbound left turn lanes	No	X
Route 14/Route 14 (Westin)	Reconfigure northbound right-turn lane	Yes	
Route 14/Route 14b	Eastbound right-turn lane, extend northbound left-turn storage	Yes	
Route 14 Traffic Circle	Traffic circle signing, striping	No	
Route 4/Route 10	Additional southbound through lane	Yes	
Route 16/Route 27a	Traffic signal modifications, signing, striping	No	X
Route 16/Route 27	Additional turn lanes	Yes	X
Route 16/Route 10a	Restriping, signage for additional turn lanes	Yes	X
Route 7/Route 7a/Route 24	Reconfigure Y-intersection	Yes	X
Route 10/Route 15	Traffic signal modifications, signing, striping	No	X

*Intersection with 30 or more crashes in 2005 and 2006.

A variety of intersection improvement projects are needed to improve traffic safety and traffic flow. Additional benefits of aesthetic improvements can also be realized in the redesigned intersections. Figure 5-11 and Figure 5-12 provide an example of one intersection located at Route 16/Route 27 both before and after proposed improvements. An extension of Route 27 from Route 16 to Route 1, also known as “Hamburger Highway,” could result in an improved intersection with recommended improvements. Modifications shown in the simulated image include roadway widening, restriping of lanes, pedestrian crossings, and possible burial of overhead utility lines.

Figure 5-11: Hamburger Highway (Route 27a)—Before

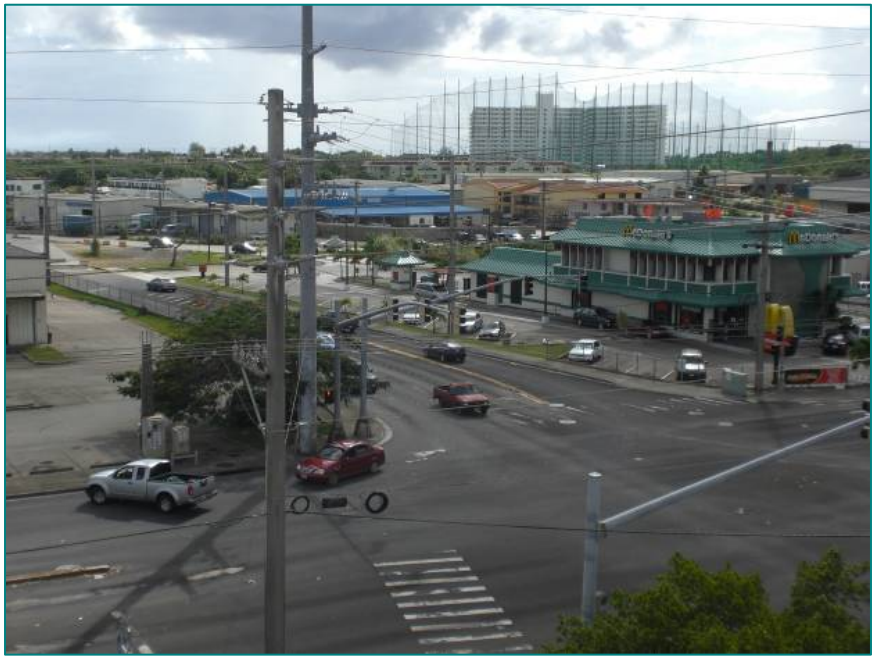
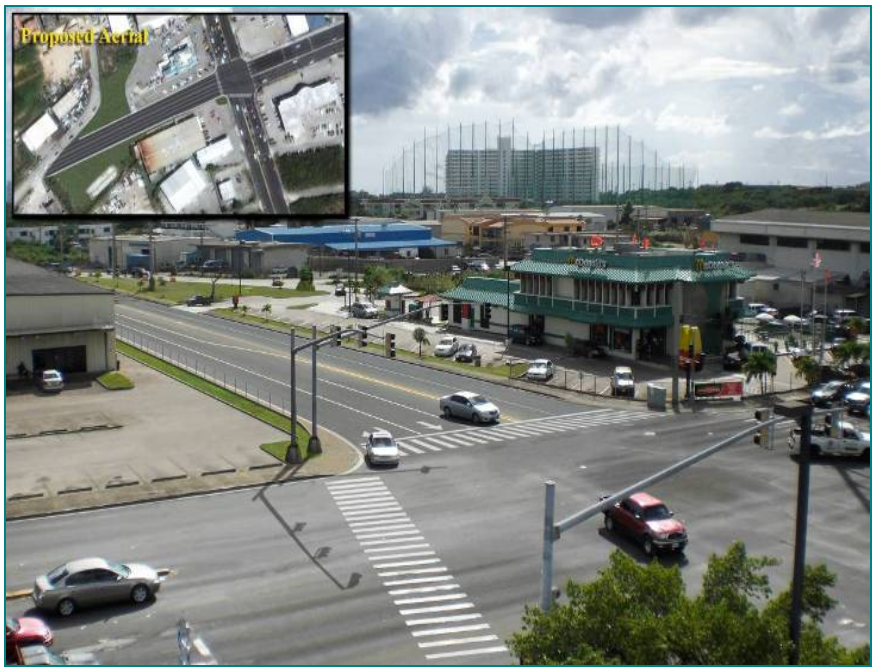


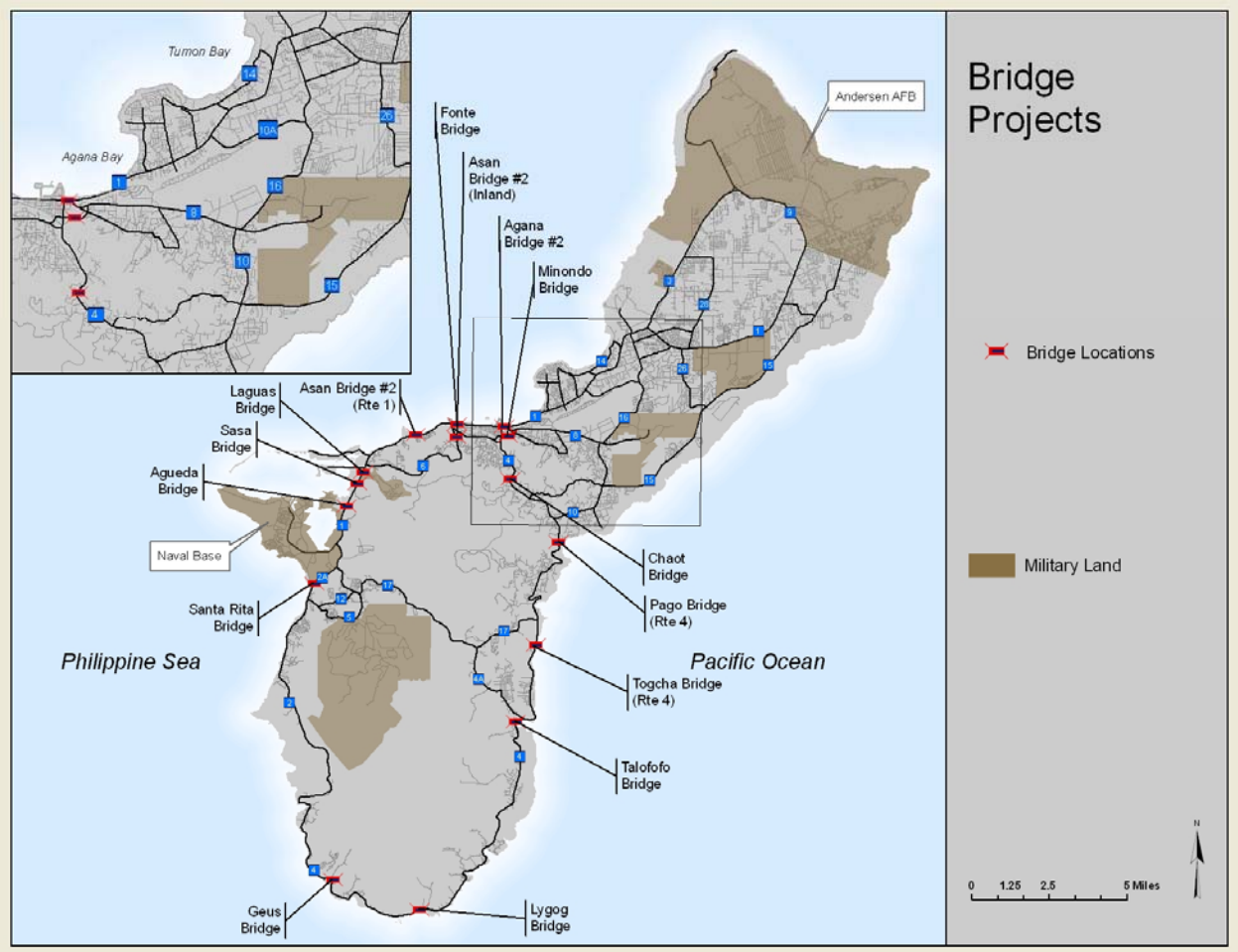
Figure 5-12: Hamburger Highway (Route 27a)—After (Simulation)



5.5.6 Bridge Improvements

The maintenance and preservation of Guam's bridges is critical to the safe and efficient movement of traffic on the island. As discussed in Chapter 3, Existing Demographic and Transportation Conditions, many of the bridges are in need of repair or replacement. Additionally, certain bridges will need to be widened to maintain consistency with the future capacity needs of the roadway on which they are located. Bridges in need or improvement are shown in Figure 5-13.

Figure 5-13: Bridge Improvements



5.5.7 2030 Village Streets Improvements

The GDPW is responsible for the development and maintenance of the local street system that serves each village on the island of Guam. These village streets consist of collector streets and residential streets that connect residential areas to the main federal-aid roadway system.

The Government of Guam has typically dedicated the revenue from the liquid fuels tax towards the operations and maintenance of village streets. In 2011, a Grant Anticipation

Revenue Vehicle (GARVEE) bond paid by the liquid fuels tax will be retired, and this funding stream will again be available for funding local streets. The GDPW intends to issue another bond to help pay for upgrades to the village streets. Approximately $2 million of annual revenue is anticipated to be available to fund the village streets program beginning in 2012; the bond package will be developed based on the anticipated revenue stream.

The village mayors were involved early in the GTP outreach program and were asked to develop a list of priority needs for their respective villages. A preliminary list of projects was identified and is the starting point for the village streets plan. A full analysis for each village and recommended comprehensive project list is under development. The priority lists that were submitted by the mayors are included in Appendix G, Village Streets Mayor Wish List.

The majority of needs related to the village streets include maintenance and preservation of the existing system. As identified by the mayors, the improvements serve the following purposes:

- Safety
- Pavement repair
- Drainage improvements
- Street lights and signage
- Road extensions, openings

Many of the needs identified by the mayors were pavement repairs to existing roadways. Table 5-11 is a summary of the total miles of roads in each of the five listed villages, both paved and unpaved roads, and the total lengths of those roadways that the mayors identified as needing repair. Of the five villages submitting priority lists, Mong-mong has identified the greatest number of lane miles needing repair, at 76 percent of all roads.

Table 5-11: Summary of Mayor's Identified Pavement Repairs

Village	Existing Road Miles Paved	Existing Road Miles Unpaved	Total Existing Miles	% of Existing Road Miles Identified for Repair*
Agat	12	2	14	71%
Inarajan	10	3	13	27%
Mongmong-Toto-Maite	16	2	18	76%
Piti	12	2	14	10%
Talofofo	12	2	14	10%
Agana Heights	15	1	16	Not reported
Asan	24	1	25	Not reported
Barrigada	54	2	56	Not reported
Chalan Pago-Ordot	35	5	40	Not reported
Dededo	194	27	221	Not reported
Hagatna	14	0	14	Not reported
Mangilao	63	9	72	Not reported
Merizo	15	1	16	Not reported
Santa Rita	86	1	87	Not reported
Sinajana	8	1	9	Not reported
Tamuning	68	2	70	Not reported
Umatac	10	1	11	Not reported
Yigo	23	8	31	Not reported
Yona	53	3	56	Not reported

*Based on priority lists submitted by village mayors.

5.6 Mass Transit Improvements

This section describes the recommended transit improvements needed to provide Guam residents a competitive choice in transportation. The transit plan consists of a core fixed-route system and demands responsive service improvements. In the long-range component of the plan, it is anticipated that high-capacity transit improvements will be needed to support mobility for residents, visitors, and military personnel traveling Route 1. It is recommended that high-capacity transit concepts for Marine Corps Drive be implemented to enhance service and connectivity to the Tamuning/Tumon Bay area. The current TTIP has programmed $20 million in funds to acquire the 50 new vehicles needed to start the system in 2012. As shown in Table 5-12, in 2015 to 2030, the GTP anticipates the replacement of the vehicles needed to start the system. The high-capacity transit service for Route 1 is likely to begin the planning process in 2015.

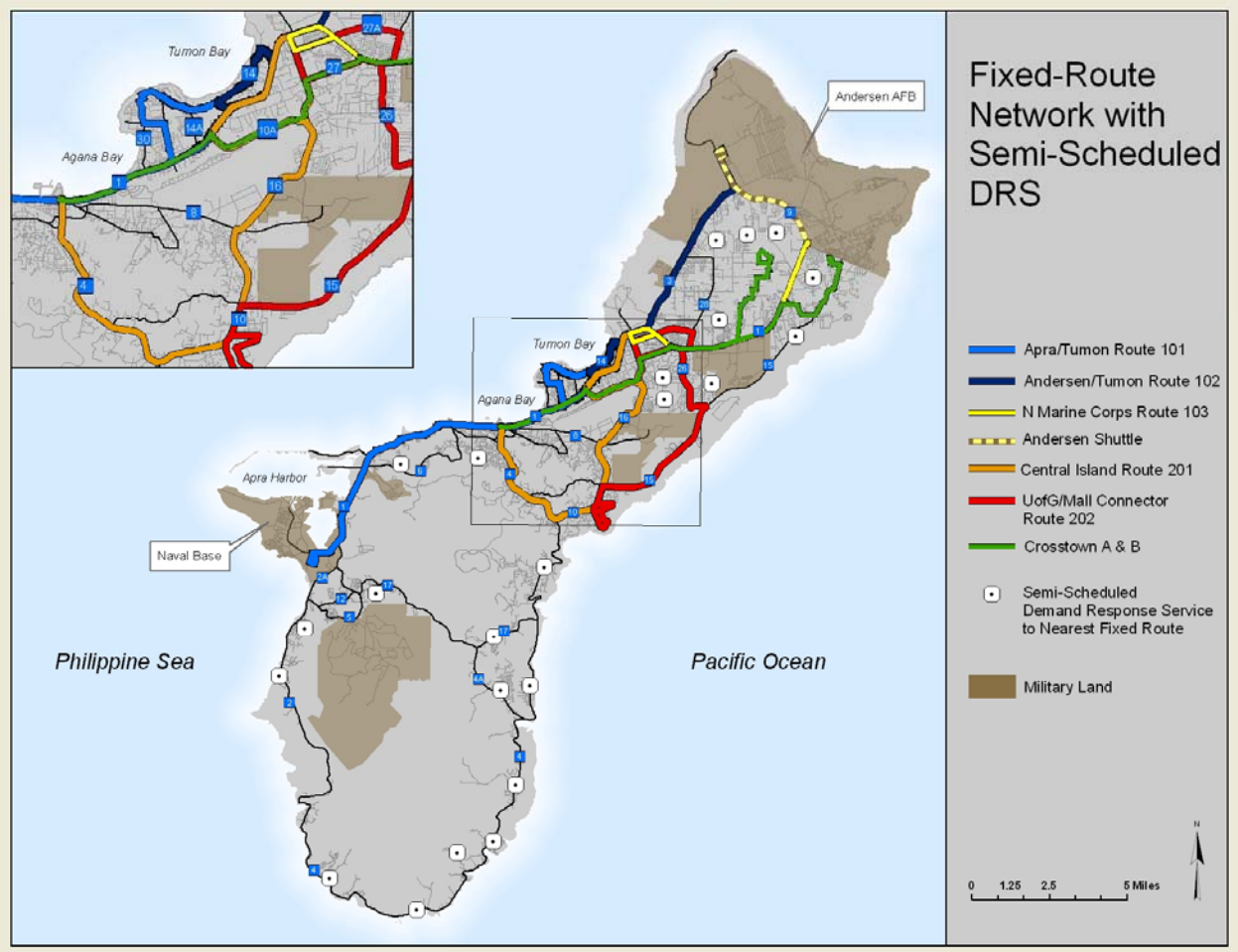
Table 5-12: Guam Transportation Plan Transit Improvements (2030)

Transit	Description
Purchase 20 paratransit vehicles	Purchase
Construct a bus maintenance facility	Construction
Purchase 10 low floor transit vehicles	Purchase
High-capacity transit service	Plan, design, construct
Purchase 25 low floor transit vehicles	Replacement buses in 2015 to 2025
Purchase 25 low floor transit vehicles	Replacement buses in 2025 to 2030

5.6.1 Fixed-Route System

The preliminary plan for the core system entails deploying five fixed routes that will provide general-purpose service. The routes connect major population and employment centers, such as Dededo in the north (the most populous residential district) and Apra Harbor in the south (a major location of jobs). The system also would connect the Finegayan facilities and the Yigo District/Anderson Air Force Base. Recommended routes are shown in Figure 5-14.

Figure 5-14: Mass Transit Fixed-Route Improvements



The daily service span for the system will be 18 hours per day. The service plan calls for 1-hour headways for each of the five routes during the base period (9 a.m. to 4 p.m. and 6 p.m. to 11 p.m.) and 30-minute headways during peak periods (6 a.m. to 9 a.m. and 4 p.m. to 7 p.m.). The total fleet requirement for this service is 50 vehicles. Low floor buses are recommended for faster and easier boarding, including direct access for people with disabilities.

Bus maintenance and administrative support facilities will also be needed. The bus maintenance facility would be designed for a fleet of up to 100 vehicles. Over the life of the GTP, it is foreseeable that the initial bus fleet of 50 vehicles will need replacement. During the 2015–2025 period, revenues are allocated to cover these capital costs.

5.6.1.1 Transit Capital and Operating Funding

The fixed-route system will include an upfront capital cost to acquire new vehicles and develop a maintenance facility. The current TTIP has allocated $20 million for the acquisition of 50 new coaches. An additional $5 million is programmed to support the development of a new maintenance facility. The Government of Guam is currently seeking FTA 5309 bus and bus facilities discretionary funding to support the capital needs.

The initial year operating costs for the new fixed-route system is $11 million per year beginning in 2012. This assumes an annual operating cost per service hour of $70, inclusive of fuel and tires, and an annual service hour level of 156,085.

5.6.1.2 High-Capacity Bus Transit Improvements

The start up for the new core fixed-route is scheduled for 2012. After two years of operations in which the system is adjusted to meet customer needs and changing demographic and economic circumstances, Route 1 should be studied for high-capacity bus transit improvements. The focus of the analysis is to install a number of technological, pedestrian, and transit improvements. An effective high-capacity bus system may use advanced designed vehicles operating frequently along this corridor. A protected right-of-way for the service may be needed between Route 8 and Route 16 in the 2025–2030 timeframe. The fixed-route system will include an upfront capital cost to acquire new vehicles and develop a maintenance facility.

5.6.1.3 Paratransit Services

The paratransit services will continue to need expansion over time. This is especially true since the general demand response services will become more integrated with the fixed-route system. The GTP recommends programming an additional 20 vehicles to serve the increasing demand for paratransit.

5.6.1.4 Mass Transit Performance Assessment

As noted in Chapter 3, improvements to mass transit on Guam could result in a four-fold increase in ridership. Based on data from the peer agency review on population density and transit productivity, it is anticipated that the population and employment on Guam could support dramatically higher transit ridership. Guam's population density is just below 800 persons per square mile. By improving service and expanding service hours, it is likely that ridership could reach between 1.56 million and 1.87 million annual riders. This assumes that between 10 and 12 passengers per service hour use the system and a new annual service hour level of 156,000. The increase would be substantial compared to the 133,000 passengers carried on the current system.

The current average fare on Guam is $0.50. Assuming the same fare policy remains in place, farebox revenues could increase from $262,000 to over $900,000 per year. This would bring the net operating cost, which is the operating cost minus the farebox revenue, to $10 million per year.

5.6.2 Immediate Opportunities for Guam Mass Transit

This section describes proposed immediate actions to organize, redesign, re-equip, and more effectively manage the island's public transportation services. This will establish a secure basis upon which to expand and improve the system. The following steps are proposed:

- Reassess fixed-route running times and reschedule service to use the current level of bus hours more effectively.
- Where feasible, replace demand-response service with fixed-route service.
- Revise routes Green Line 1 and Grey Line 4 to avoid combined fixed-route and demand-response service; consider replacing their large-loop design with separate routes or provide two-way service on the loops.
- Institute a new program to determine paratransit eligibility and design it to be self-maintaining and to drop those whose eligibility expires.
- If determined to be feasible and more economical, provide paratransit service using taxis rather than buses.
- Initiate new public information/awareness and passenger services, such as sources of schedules, pass sales, route maps, and real-time bus arrival information.
- Initiate specific transit system management actions, including new bus service verification processes.

It is anticipated that implementation of these actions would result in at least doubling the number of passengers carried by Guam Mass Transit. One can expect also that such improvements would demonstrate the potential for further substantial, productive improvement and raise public interest in seeing expansion of the transit system. Realization of these effects will set the stage for making public transportation a significant part of Guam's program to obtain greater mobility in anticipation of the major growth of population and economic activity as a result of the planned military build-up.

5.7 Pedestrian and Bicycle Improvements

The policy of the GDPW is to integrate bicycling options and sidewalks into the transportation system as a means to improve mobility and safety of non-motorized traffic. Bicycle and pedestrian facilities will be included in any roadway reconstruction or construction of new roadway facilities. The level of improvement will vary depending on the existing roadway conditions. Figure 5-15 and Figure 5-16 show the types of pedestrian/bicycle elements that will be considered on future roadway reconstruction and widening projects.

Figure 5-15: Pedestrian Facility Improvements

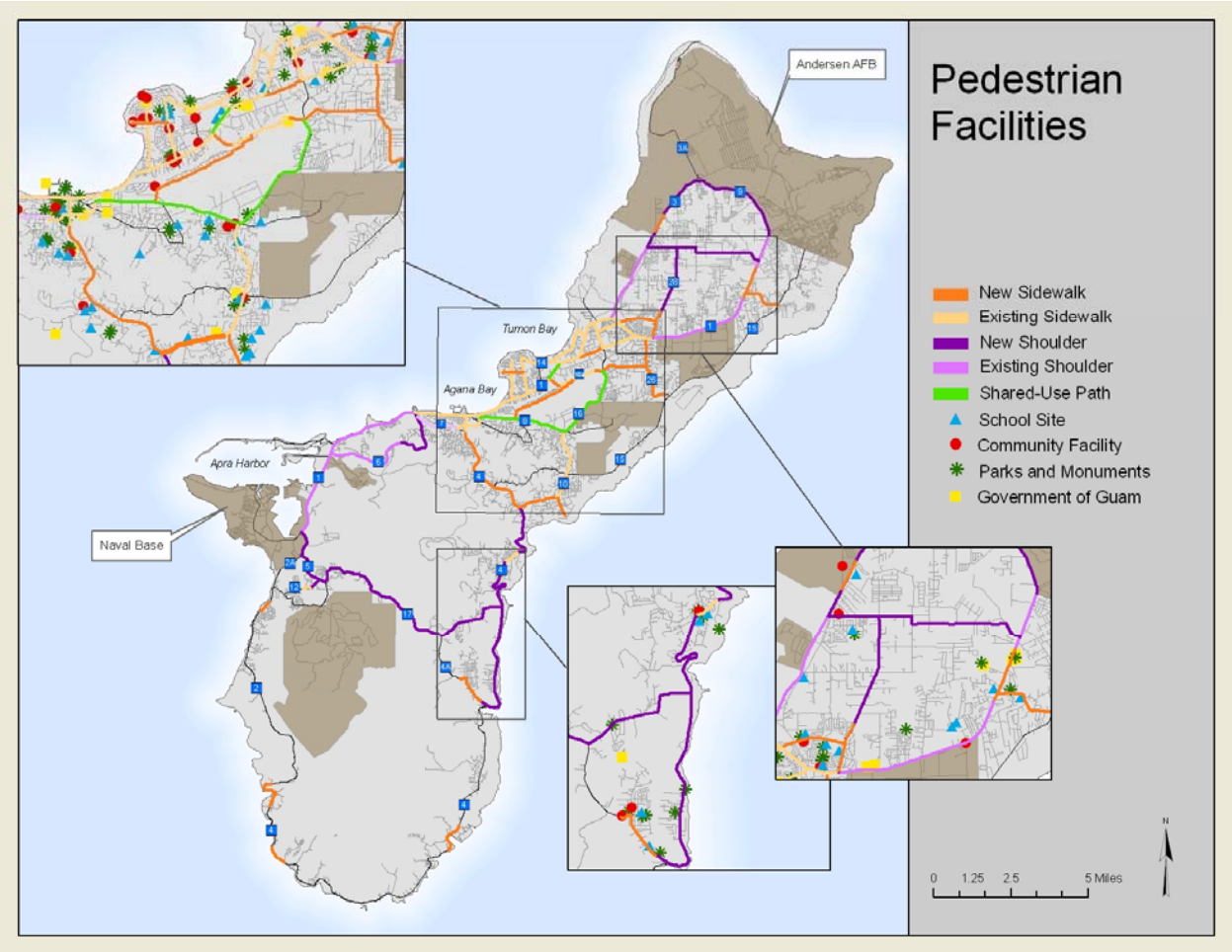
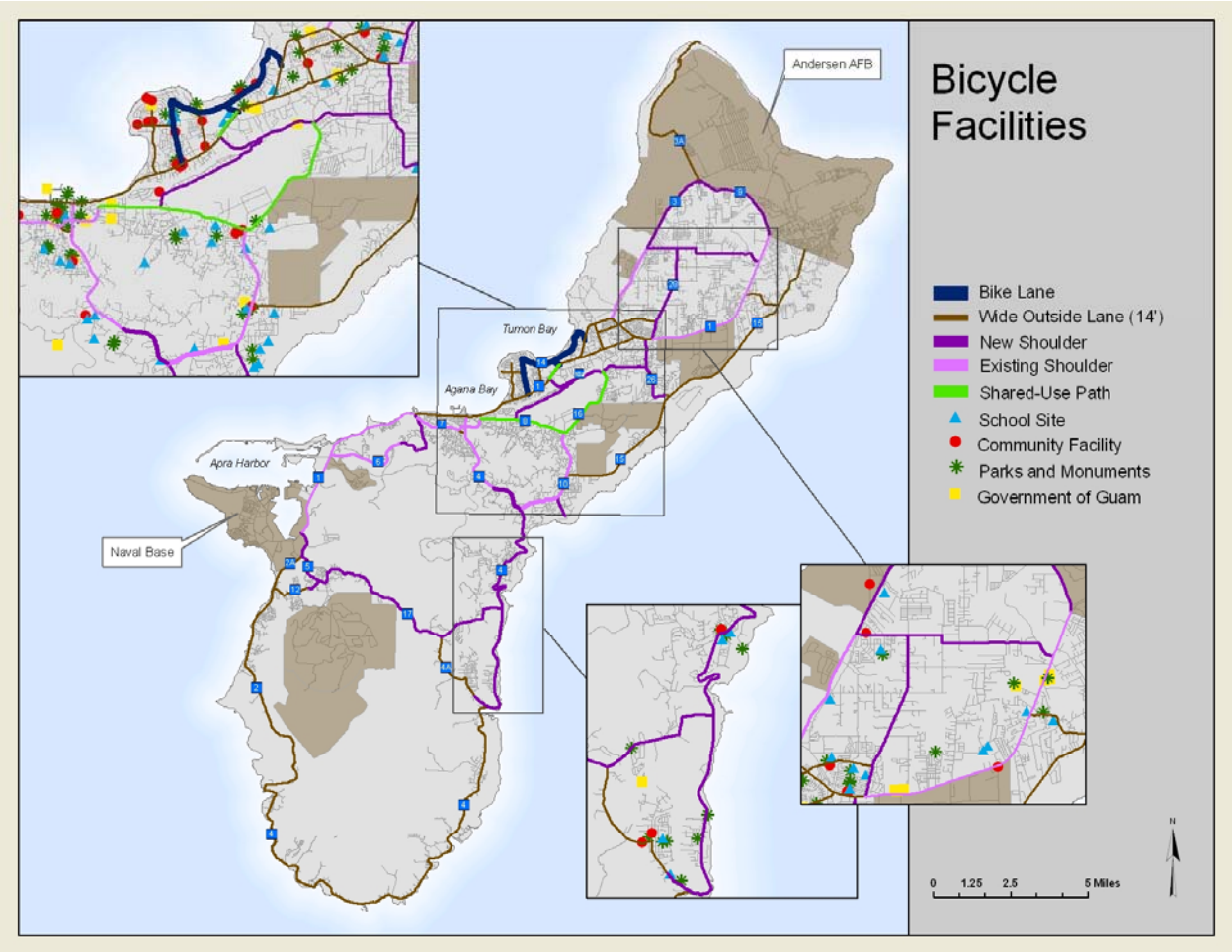
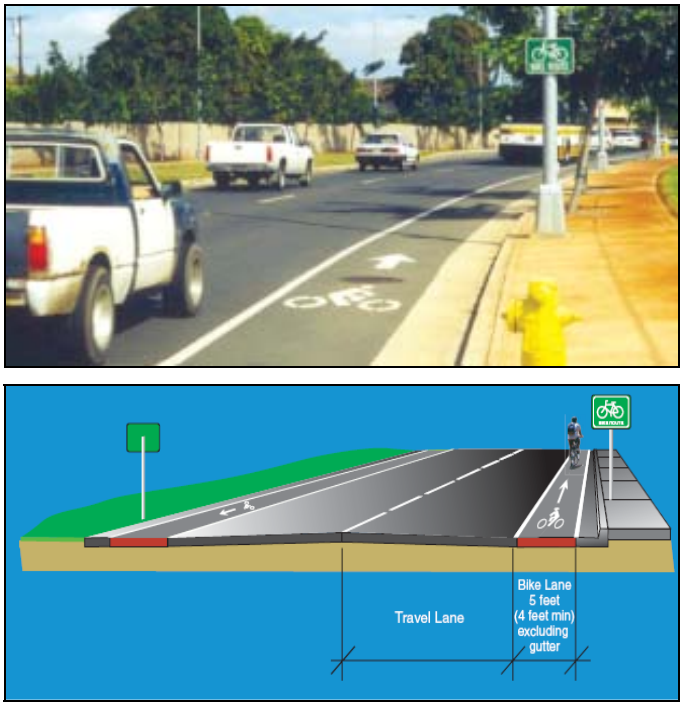


Figure 5-16: Bicycle Facility Improvements



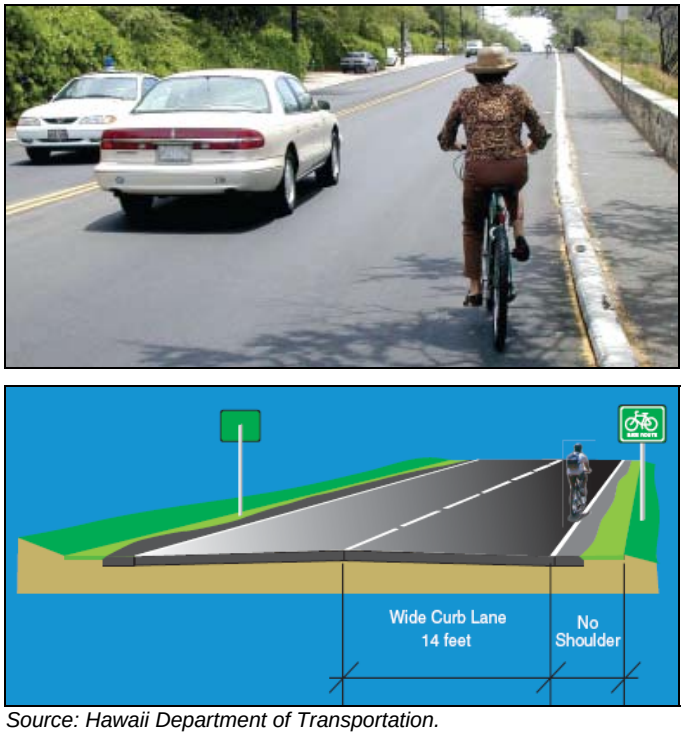
The improvements may include providing a 4-foot-wide shoulder or marked bike lane (Figure 5-17), widening the outside lane to 14 feet (Figure 5-18), completing a partially existing sidewalk, or constructing a new sidewalk or shared-use path. A shared-use path is a detached (or possibly attached) concrete trail that is a minimum of 8 feet wide to safely accommodate both pedestrian and bicyclist travel. Sidewalks are generally most appropriate in urban areas, while expanded road shoulders are more suitable to rural environments. Pedestrian and bicycle improvements are prioritized in areas near schools, parks, or community centers, where feasible. The intent of these improvements is to promote and facilitate the increased use of non-motorized modes of transportation.

Figure 5-17: Marked Bicycle Lane



Source: Hawaii Department of Transportation.

Figure 5-18: Wide Outside Travel Lane

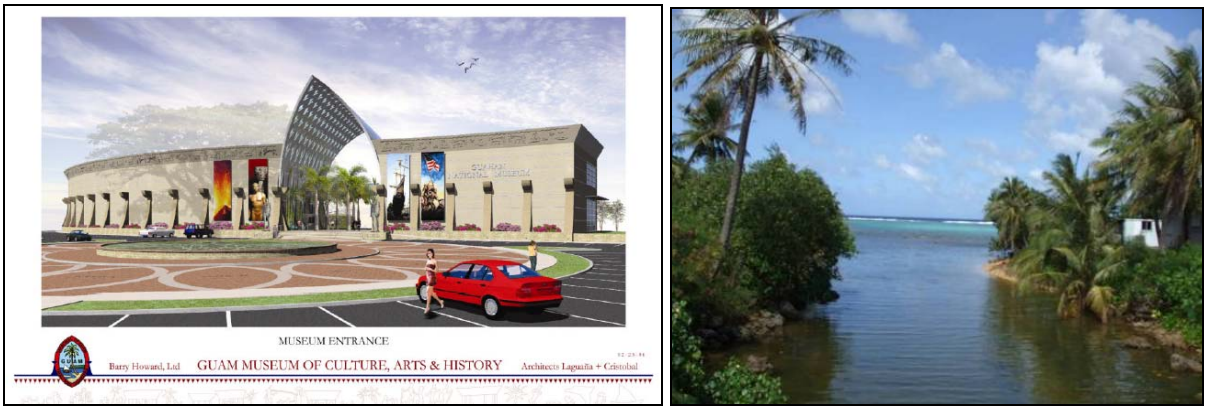


Source: Hawaii Department of Transportation.

5.8 Transportation Enhancements

There are many types of transportation-related projects that can improve the traveling experience for everyone who uses the transportation system on Guam. These projects may include aesthetic improvements, such as streetscaping, lighting, and signage; enhancements, such as visitor centers or transportation-related museums; or environmentally-based improvements, such as seashore protection (Figure 5-19).

Figure 5-19: Transportation Enhancement Projects—Guam Transportation Museum and Seashore Protection



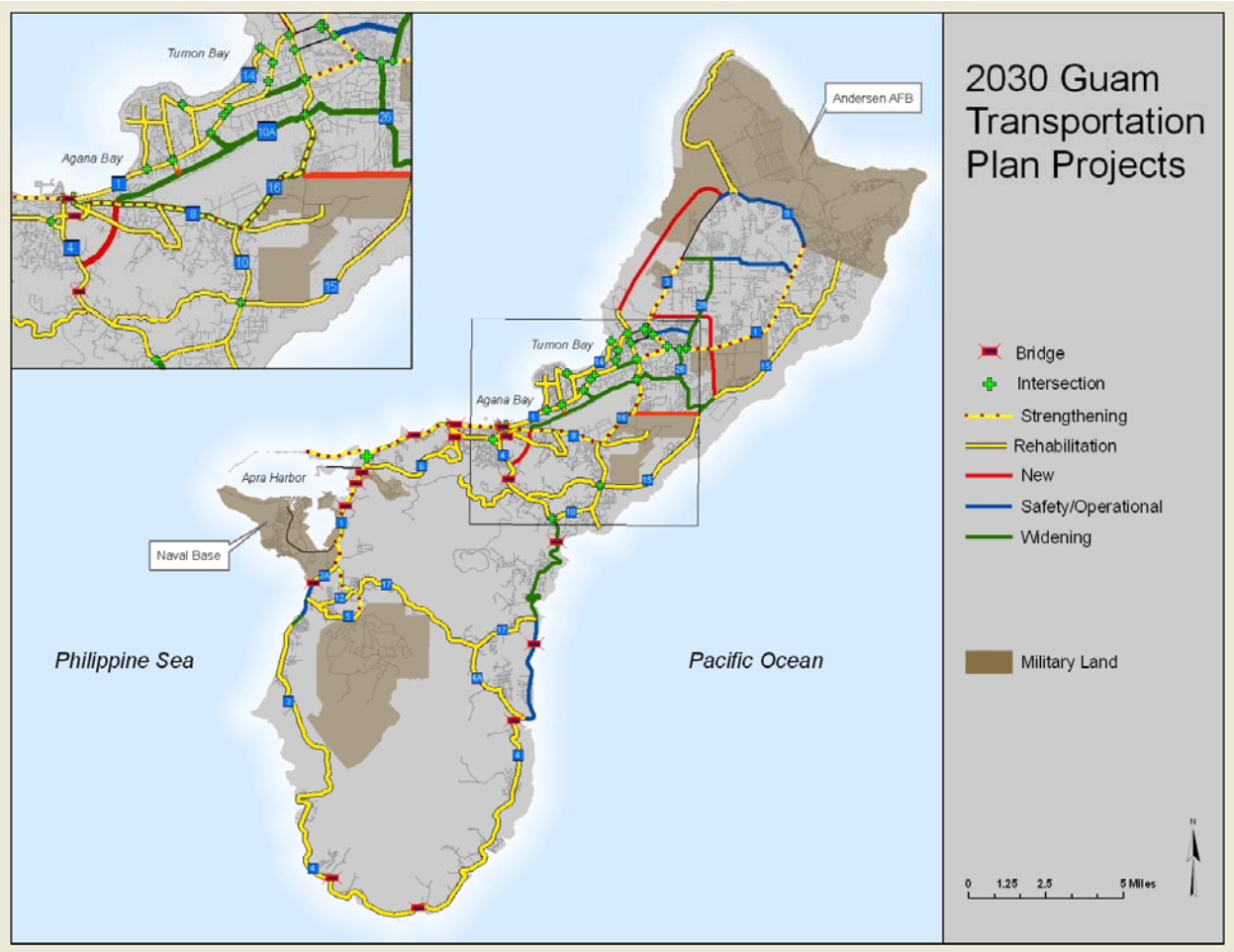
There are two such projects of particular importance to Guam today—the Guam Transportation Museum and seashore protection. The Government of Guam needs to fully utilize the opportunities to develop enhancement projects for these efforts and others that may arise in future years.

5.9 Summary

This chapter has identified a comprehensive list of transportation improvement needs for Guam based on quantitative performance measures and qualitative community input. This list of needs is unconstrained by fiscal limitations—if Guam had unlimited funds, all of the identified projects would be implemented. The unconstrained, needs-based plan is shown in Figure 5-20.

However, the reality is that funding is limited and this comprehensive needs assessment will need to be prioritized to provide a realistic and feasible plan. The project evaluation criteria, discussed early in this chapter, provide the basis for prioritizing projects. Chapter 7, Policy Recommendations, discusses the prioritization process and how it was used to develop a financially constrained improvement plan.

Figure 5-20: Needs-Based Transportation Plan Projects



6.0 CAN WE AFFORD IT?

This financial planning chapter presents a financially feasible transportation plan that meets the needs of Guam and satisfies the applicable regulatory requirements. In order to satisfy the requirement for a financially constrained plan, revenues are first projected for the planning period (2008–2030) for the major transportation funding sources that are available through federal and local government. Then, based upon the projected funds availability, the restrictions governing the use of particular funding sources, and the other inputs for GTP project selection, projects are proposed that fit the available budget.

In recognition of the fact that the transportation needs of Guam are greater than the funds likely to be available, an "illustrative projects list" is presented to show beneficial transportation projects that could be built if funds were available.

6.1 Funds for Transportation

The ability to maintain, improve, and enhance transportation facilities and services on Guam depends on adequate financial resources. This section describes the various revenue sources available for transportation projects, a summary of Guam's historic transportation revenue trends, and a forecast of anticipated revenue for the island during the plan horizon.

Financial assumptions were developed in consultation with the Government of Guam and FHWA. Revenue forecasts were developed based on historical and existing funding levels and anticipated inflationary factors.

6.2 Revenue Sources

Funding for Guam transportation projects comes from several sources: local funds generated by the local liquid fuels tax, emergency relief funds, and federal funding through the Territorial Highway Program (THP) and the FTA. Descriptions of these programs are found below.

6.2.1 Territorial Highway Program

The primary source of funding for projects is federal money received by Guam through the THP. The FHWA provides funds for Guam through the current federal transportation authorization, SAFETEA-LU. Section 1103(a) provides the following funds: FY2005–2006: $16 million per year, FY2007–2009: $20 million per year (less the obligational ceiling).

The THP was created by Section 112 of the Federal-Aid Highway Act of 1970 (Public Law 91-605) by adding Section 215 to Title 23, United States Code (USC). Federal financial assistance was granted to the Virgin Islands, Guam, and American Samoa for the construction and improvement of a system of arterial highways and necessary inter-island connectors through the General Fund of the Treasury. Under 23 USC 215(b)(1), the intent of the THP is to assist each territory in the construction and improvement of a system of arterial and collector highways and necessary inter-island connectors. This system is referred to as the Territorial Highway System (THS).

6.2.1.1 THP Funding & Obligation Authority

The THP has evolved through nearly 40 years of federal legislation to its most recent form as detailed in SAFETEA-LU. SAFETEA-LU continued the funding for the THP from a set-aside of the National Highway System (NHS) funds. Under 23 USC 104(b)(1)(A), as amended by Section 1103(c) of SAFETEA-LU, $40 million is authorized for the THP for each of fiscal years 2005 and 2006 and $50 million for each of fiscal years 2007, 2008, and 2009.

Under the provisions of Section 1102(f) of SAFETEA-LU and Section 110(e) of the DOT Appropriations Act, "Redistribution of Certain Authorized Funds," only the amount of the authorized funds for which obligation authority is provided will be made available for obligation. The remaining funds will not be available for the THP but are distributed to the states in accordance with Sections 1102(f) and 110(e). As a result, the actual allocation to be distributed to the territories each year is determined by multiplying the SAFETEA-LU authorized amount by the calculated obligation limitation percentage for that fiscal year.

The funding available to the territories each year will continue to be distributed among the four territories based on the following administrative formula that has been used since FY1993:

- American Samoa—10%
- Guam—40%
- Northern Mariana Islands—10%
- U.S. Virgin Islands—40%

6.2.1.2 Federal Share

Under 23 USC 215(b)(2), the federal share for this THP funding is in accordance with 23 USC 120(h), which states that the federal share for any project under Title 23 in the Virgin Islands, Guam, American Samoa, or the Commonwealth of the Northern Mariana Islands is 100 percent.

6.2.2 Emergency Relief Program

Congress authorized in 23 USC 125, a special program from the Highway Trust Fund for the repair or reconstruction of federal-aid highways and roads on federal lands which have suffered serious damage as a result of natural disasters or catastrophic failures from an external cause. This program, commonly referred to as the emergency relief (ER) program, supplements the commitment of resources by states, their political subdivisions, or other federal agencies to help pay for unusually heavy expenses resulting from extraordinary conditions.

The applicability of the ER program to a natural disaster is based on the extent and intensity of the disaster. Damage to highways must be severe, occur over a wide area, and result in unusually high expenses to the highway agency. Applicability of ER to a catastrophic failure due to an external cause is based on the criteria that the failure was not the result of an inherent flaw in the facility but was sudden and caused a disastrous impact on transportation services.

For the purposes of 23 USC 125, the federal-aid highways in the territories are those on the approved THS, which include the major roads on Guam. In accordance with Subsection 125(f), for purposes of the emergency relief program, the territories are considered as states. Under the provisions of Section 125(d), the annual obligation limitation for ER funding in the territories as a group is $20 million.

For the purpose of expense planning in the GTP, the only ER revenues programmed are funds previously authorized for permanent restoration of damaged infrastructure resulting from typhoons Chata'an, which occurred July 5, 2002, and Pongsona, which occurred December 8, 2002. If another disaster strikes during the life of this GTP, funds will be authorized to Guam from the ER program and obligated over and above the current value of Guam's GTP.

6.2.3 Liquid Fuels Tax

Guam collects the following revenues on the sale of liquid fuels:

- Gasoline tax
- Gasoline tax surcharge
- Diesel fuel tax
- Diesel fuel tax surcharge

Liquid fuels taxes are not a large source of revenue for highway projects. The majority of these funds are used for operations and maintenance or repayment of an existing bond obligation. It is estimated that only approximately 17 to 20 percent of the annual revenues collected can be used for new transportation capital investments. Historic revenues are shown in Table 6-1 and current tax rates are shown in Table 6-2.

Table 6-1: Historic Revenues (FY2004–FY2007)

Type of Funding	FY 2004	FY 2005	FY 2006	FY 2007
Liquid Fuel Taxes (less Aviation Fuel Tax)	$4,966,652	$12,255,967	$7,481,433	$7,703,748

Table 6-2: Current Tax Rates

Source	Category	Rate
Fuel tax	Automotive diesel fuel	$0.14 per gallon*
	Gasoline (automotive)	$0.15 per gallon*
Vehicle registrations	Estimated average	$30 per vehicle

*Includes a $0.04 per gallon surcharge

6.2.4 Federal Transit Administration

The following section details anticipated revenue sources from the FTA.

6.2.4.1 FTA 5309—Transit Capital Investments

This program provides funding for the establishment of new rail or busway projects (new starts), the improvement and maintenance of existing rail and other fixed guideway systems that are more than seven years old, and the upgrade of bus systems. Currently, Guam is seeking to obtain a Section 5309 earmark for the construction of mass transit.

6.2.4.2 FTA 5310

This capital grants funding program was established by the FTA (Section 5310) for meeting the transportation needs of elderly persons and persons with disabilities in areas where public mass transportation services are otherwise unavailable, insufficient, or inappropriate. It allows for the procurement of accessible vans and busses, communication equipment, mobility management activities, and computer hardware and software for eligible applicants.

6.2.4.3 FTA 5311

Section 5311 is a non-urbanized area formula funding program authorized by 49 USC 5311. This federal grant program provides funding for public transit in non-urbanized areas with a population under 50,000 as designated by the Bureau of the Census. FTA apportions funds to each state and territory annually.

6.2.4.4 FTA 5316

The Job Access and Reverse Commute program goals are to improve access to transportation services to employment and employment-related activities for low-income individuals and welfare recipients and to transport residents of urbanized areas and non-urbanized areas to suburban employment opportunities.

6.2.4.5 FTA 5317

The New Freedom formula grant program aims to provide additional tools to overcome existing barriers facing Americans with disabilities seeking integration into the work force and full participation in society. The New Freedom formula grant program seeks to reduce barriers to transportation services and expand the transportation mobility options available to people with disabilities beyond the requirements of the ADA of 1990.

6.3 Short-Term Funding Availability (TTIP)

The TTIP is a subset of the longer-range GTP. All of the projects included in the four-year TTIP are included as the highest priority in the GTP. The funds that are available in the TTIP are also included in the GTP. Details of the first four year's worth of revenue are shown in

Table 6-3 below. As detailed in Table 6-3, the GDPW is poised to spend over $158 million in transportation projects over the next four years.

Table 6-3: Available Highway Funding by Government of Guam (TTIP)

Calendar Year	Source of Funds	Amount
2008	Unexpended Previous Years' Allocations	$ 71,193,915
	American Samoa Loan Repayment	$ 1,500,000
	Reprogrammed Emergency Relief Funds	$ 12,255,937
	FHWA Annual Allocation '08 (Net)	$ 18,400,000
2009	FHWA Annual Allocation '09 (Net)	$ 18,400,000
2010	FHWA Annual Allocation '10 (Net)	$ 18,400,000
2011	FHWA Annual Allocation '11 (Net)	$ 18,400,000
Total		$158,549,852

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The Government of Guam currently has approximately $90 million in unexpended federal highway funds. Guam's federal funds are currently being prioritized and are programmed to address needs of the local community that have not been addressed over many years, such as collapsing bridges, flooding roads, poor lane visibility, high accident locations, potential landslides, eroding embankments, shoreline protection, traffic signal installations and other immediate needs.

Additionally, Guam has available Transportation Improvement Earmarks of $16 million. Section 1934 of SAFETEA-LU earmarks funds for high-priority projects. Guam has received $16 million from Section 1934 for the projects listed in Table 6-4.

Table 6-4: Transportation Improvement Earmarks

TTIP #	Project	Village	Estimated Cost
438	Reconstruct Hagatna river bridges	Hagatna	$6,600,000
439	Construct Cabras Island Intermodal Facility, Route 11	Piti	$6,000,000
440	Acquisition of transit vehicle for disabled persons	N/A	$400,000
441	Construct Route 3a extension	Yigo	$3,000,000

6.4 Future Revenue Projections

It is estimated that there will be approximately $647 million in transportation-related revenue available to Guam over the life of the GTP (2012–2030), as shown in Table 6-5. These funds will come from a variety of sources including:

- Annual allocations from the THP
- Vehicle registration fees
- Liquid fuels taxes
- DAR funding (to support military-related transportation needs)
- Annual FTA allocations

- Federal earmarks
- Transit operating appropriations authorized by Guam legislature

Table 6-5: Estimated Revenue (2012–2030)

Funding Source	Revenue
FHWA (Territorial Highway Program)	368,671,000
Village streets (vehicle registrations and liquid fuels tax)	47,820,000
Department of Defense (DAR Program)	50,000,000
FTA	117,350,000
Total All Funding Sources	**$ 647,386,000**

The funding sources identified above are those that have either been historically available to the Government of Guam or are those that are reasonably expected to be available to Guam in the immediate future. As discussed above, the funds shown in the four-year TTIP are included in the revenue forecast in the GTP.

Historically, funding for transportation improvements has been provided mainly by FHWA and FTA. However, there are a variety of other funding/financing options that Guam is exploring. These additional options can provide a vehicle for other contributing parties to help pay for the impacts on the transportation system. For example, new residential, commercial, and industrial developments impact the roadways and should have a role in the related transportation improvements required as a result of the developments.

Additionally, as discussed in previous chapters, the impacts of the proposed military build-up will have tremendous impacts on Guam's transportation system. GDPW and military representatives have been coordinating to determine the level of participation that the military should have in providing improvements to the roadways of Guam.

Potential funding/financing sources that are under review include:

- Department of Defense military construction funds
- Impact fees and system development charges
- Dedications
- Public-private partnerships
- Debt instruments
- Legislative commitments

6.4.1 Defense Access Road Funding Request

In cooperation with the military, Guam submitted a needs request for consideration of DAR funding for the HRN required improvements in the FY2010–2014 USDOD Presidential Budgets for Construction. Guam worked in cooperation with the Joint Guam Program Office (JGPO) to develop the Needs Assessment Report which was submitted to the Department of the Army Military Surface Deployment and Distribution Command for consideration. The Needs Assessment Report was developed based on information

discussed above and through analysis completed for the GTP. The DAR justification documents establish requirements, priorities, and construction activities descriptions.

A Form 1391 funding request was submitted to the Department of the Army for FY2010 military construction, and it is anticipated that approximately $50 million will be available to Guam in FY2009 through the DAR program.

6.4.2 Innovative Financing

The Government of Guam does not have the financial resources to support major infrastructure investments, especially at the level required for the development of the infrastructure facilities associated with the military build-up. Guam's funding resources are already over-extended, and the current level of U.S. federal support is fully committed to meeting the transportation needs of the existing population.

The Government of Guam is looking into the availability of additional federal grants to help fund infrastructure improvements. The Interagency Working Group will have discussions as to whether such grants exist and, if so, the methods to apply for these grants. However, the gap that exists between available resources and needs is such that even if additional federal grant money can be accessed, it will not provide an adequate source of revenue to cover the outstanding need.

For Guam to attract external or private financing and capital to its projects, it would first need to identify a cash flow stream that could be pledged for repayment or equity return. Often, user fees are enacted to provide this cash and can take the form of direct payments, like tolls, or indirect fees, such as taxes or special assessments. The challenge in any such mechanism is to charge those who benefit from the improvement while not penalizing those who do not. Given Guam's poor credit rating, it is likely that even with an identified cash flow, some additional credit support or enhancement would be required. The recently introduced U.S. Territories Bond Bank Authorization Act could serve that purpose, if enacted, as could some form of future funding agreement from a U.S. agency such as FHWA or USDOD. A variety of bond market mechanisms can be used to reduce the overall cost of any borrowing, provided credit support is in place.

The FHWA has several programs in place to assist public sponsors in financing and funding large programs. Details of two of these programs are provided below.

6.4.2.1 GRANT ANTICIPATION REVENUE VEHICLES

GARVEE (Grant Anticipation Revenue Vehicles) bonds are eligible for federal reimbursement on any federal-aid project eligible under Title 23. GARVEEs permit states and territories to pay debt service and other bond-related expenses with future federal highway apportionments. There are two forms of GARVEEs when referring to the debt-related costs that are eligible for reimbursement: Direct and indirect GARVEEs. Additional information on these types of GARVEEs is provided below.

- *Direct GARVEEs*, when approved by FHWA, are bonds that are issued for a specific project or set of projects and are eligible for federal reimbursement for the principal, interest, and issuance costs associated with the GARVEE bonds. The share of federal reimbursement is dependent on the overall local/territorial funding contribution from either the debt service payments or other funding

sources to ensure that the appropriate total federal/territorial pro-rata is achieved for the project. Direct GARVEEs require a project payment agreement between FHWA and the state or territory's department of transportation. The costs that can be covered with direct GARVEEs include principal and interest costs, as well as the issuance costs and credit enhancement fees.

- *Indirect GARVEEs* are not attributed to a particular project or set of projects; rather, they are issued to support an entire territorial program. Indirect GARVEEs do not receive federal reimbursements for interest and issuance costs. One of the main benefits of indirect GARVEEs is that states and territories have the flexibility to substitute projects that are funded with indirect GARVEEs without the requirement of FHWA approval. With indirect GARVEE bonds, issuance costs and credit enhancement fees are not reimbursable.

Candidates for GARVEE financing are typically large projects or programs that have the following characteristics:

- They are large enough to merit pay-as-you-go grant funding, with the costs of delay outweighing the costs of financing.
- They do not have access to a revenue stream (such as taxes or tolls) and other forms of repayment (such as state or territory appropriations) are not feasible.
- The sponsors of the projects are willing to reserve a portion of future federal-aid highway funds to satisfy debt service requirements.

The steps in the GARVEE process are as follows:

- State seeks approval for advance construction of GARVEE project(s).
- State makes election to receive reimbursements for construction or debt service.
- FHWA approves project as debt-financed project and executes project agreement(s).
- State issues bonds and uses proceeds for construction.
- State requests partial conversion of advance construction (AC) project(s) for semi-annual/annual debt service payments.
- FHWA obligates federal funds for requested debt service payment.
- State claims reimbursement for federal share of bond debt service and funds are paid to state account.
- State uses federal-aid reimbursement for debt service on bonds.

Projects eligible for GARVEEs must be eligible for federal-aid highway funding under one or more program funding categories for which advance construction is available. The projects must also appear on the TTIP. Projects funded with the proceeds of GARVEE debt instruments are administered in the same manner and are subject to the same requirements as other Title 23 projects.

The following bullets summarize the additional characteristics of GARVEE bonds:

- Bond-related costs that are reimbursable for direct GARVEEs include
  - principal and interest payments
  - issuance costs (underwriters discount, rating agency fees, printing, publication, advertising expenses, expenses of registrars/paying agents, attorney fees, financial advisors, bond counsel, accountants, feasibility consultants, or other experts required for sale and issuance of bonds)
  - credit enhancement fees, including insurance, premiums, and letter of credit fees
  - other costs incidental to a financing (on-going agent/trustee fees and audit costs)
- Eligible GARVEE project or program debt is not backed by the federal government; the federal government only agrees to permit the use of future federal-aid as the source of repayment. The issuer of the debt is ultimately responsible for debt service payments to the bond holders.
- To follow the appropriate federal-aid procedures, the project would be established where the federal share of debt-related costs anticipated to be reimbursed with federal-aid funds over the life of the bonds should be designated AC.
- Debt service payments to be made from federal-aid reimbursement for debt service (AC conversion) should be included in the TIP.
- Approval of the project to be debt-financed is required from the FHWA Division Office.
- Approved projects then seek reimbursement for debt service rather than reimbursement of construction costs (there are exceptions where a project can received a combination of the two—FHWA approval is required). Debt service reimbursement schedules must be included in the project agreement documentation.
- Calculation of repayment:
  - Where project costs are 100 percent debt financed through one bond issue, bond-related repayment may be measured where 80 percent of the payment will be made from federal-aid for an 80 percent federal, 20 percent state eligible project.
  - Project costs that are funded by a combination of sources could be programmed differently. Example: federal share could be debt financed while local share is pay-as-you-go or via “in-kind” match, such as donated property or toll credits.
- Tapered match is not permitted on debt-related federal reimbursements.
- A trustee or other depository can receive federal-aid debt service payments directly from FHWA.
- Federal funds may be used to reimburse the federal share of any cost over-runs.

6.4.2.2 Transportation Infrastructure Finance and Innovation Act

Created in 1998 under Transportation Equity Act for the 21st Century (TEA-21), the Transportation Infrastructure Finance and Innovation Act (TIFIA) is a credit assistance program administered by USDOT. The program's goal is to provide credit rather than grants to sponsors of surface transportation projects. TIFIA instruments often take a subordinate position to other project debt, enabling "borderline" projects to borrow from capital markets on more favorable terms. However, that subordinate position rises to parity in the case of project default, making TIFIA less attractive as a financing option.

The fundamental goal of the TIFIA program is to leverage federal investment by encouraging private and other non-federal investment in transportation projects of regional or national significance. The USDOT directly negotiates with private and public sponsors of eligible transportation projects and, because the TIFIA legislation authorizes new funding for such credit assistance, TIFIA does not draw from funds already apportioned to the states or territories for grant-assisted projects.

TIFIA offers three forms of credit assistance: secured (direct) loans, loan guarantees, and standby lines of credit. Direct loans reimburse a project sponsor's expenditures for eligible project costs, including right-of-way acquisition, design, construction, and financing costs. Loan guarantees and lines of credit provide sources of capital should project revenues fall short of amounts needed to repay commercial project investors. TIFIA credit instruments can offer project sponsors an excellent way to boost debt service coverage and enhance senior project obligations at an affordable cost, giving projects similar borrowing rates to tax-exempt bonds and fewer restrictions on private participation than tax-exempt bonds.

Because TIFIA offers credit assistance and not federal grants, projects must have a dedicated revenue source to repay debt. The revenue source could be a tax, tolls, user fees (e.g., a passenger facility charge), passenger fare revenues, local jurisdiction payments, lease/rent payments, or other dedicated sources. Further, a project must first be "credit worthy" (able to demonstrate its ability to obtain an investment-grade rating on senior debt) before it can receive TIFIA credit assistance, and projects may only request TIFIA credit assistance of up to 33 percent of eligible project costs.

In general, to be eligible for TIFIA credit assistance, a project must be eligible for grant assistance from applicable federal surface transportation funding programs, and the project rules are the same as those for grant assistance. Highway, transit, passenger rail, and certain intermodal projects are eligible to receive TIFIA assistance. These include any project eligible for regular grant funding under USC Chapter 1 of Title 23 (highways) or Chapter 53 of Title 49 (public transit). Eligible projects may also include intercity passenger bus or rail facilities and vehicles (including Amtrak) and publicly owned intermodal surface freight transfer facilities, so long as these facilities are located on or adjacent to NHS routes and are not airports or seaports.

Both public and private entities may apply for TIFIA assistance. Such entities include, but are not limited to, state departments of transportation, local governments, transit agencies, special authorities or districts, railroad companies, and private firms or

consortia. However, intermodal freight transfer facilities must be publicly owned to receive TIFIA assistance.

The project costs that are eligible for TIFIA assistance include the following:

- Development phase activities (planning, feasibility analysis, revenue forecasting, environmental review, permitting, preliminary engineering and design work, and other preconstruction activities)
- Construction, reconstruction, and rehabilitation
- Acquisition of real property
- Acquisition of equipment and materials
- Construction contingencies
- Costs of environmental mitigation
- Certain financing costs, including capitalized interest, reasonably required reserve funds, and debt issuance expenses

It is important to note that costs incurred more than three years before the date of the application for TIFIA assistance will be considered on a case-by-case basis to be deemed eligible.

A lengthy application is required for TIFIA assistance, and projects are evaluated according to how well they score on eight selection criteria. These criteria include the following:

- *National or Regional Significance*—the extent to which the project is nationally or regionally significant, in terms of generating economic benefits, supporting international commerce, or otherwise enhancing the national transportation system.
- *Creditworthiness*—the creditworthiness of the project, including a determination by the Secretary that any financing for the project has appropriate security features, such as a rate covenant, to ensure repayment.
- *Private Participation*—the extent to which assistance would foster innovative public-private partnerships and attract private debt or equity investment.
- *Project Acceleration*—the likelihood that assistance would enable the project to proceed at an earlier date than would otherwise be possible.
- *Technological Innovation*—the extent to which the project uses new technologies, including intelligent transportation systems, which enhance the efficiency of the project.
- *Budgetary Cost*—the amount of budget authority required to fund the federal credit instrument made available to the project.
- *Environmental Impacts*—the extent to which the project maintains or protects the environment.
- *Reduction of Grant Assistance*—the extent to which credit assistance would reduce the contribution of federal grant assistance to the project.

The process for approval of TIFIA assistance can be very time consuming and includes the following general steps:

- Project sponsor submits letter of interest to USDOT to determine if the project meets basic eligibility requirements.
- If eligibility is confirmed, sponsor submits application, including fee, and makes oral presentation to USDOT.
- USDOT determines whether to provide TIFIA credit assistance.
- If project is selected, USDOT issues term sheet details that commits to the basic credit assistance.
- USDOT and project sponsor negotiate and execute final loan agreement.
- (If direct loan) Loan proceeds are disbursed on agreed draw down schedule; project sponsor draws down funds to reimburse project costs.
- (If direct loan) Project sponsor repays USDOT per the terms of the credit agreement.

As of 2007, the TIFIA program was authorized to support more than $2 billion of average annual credit assistance and has provided at least $3.2 billion of credit assistance, with significant unused capacity.

6.4.3 Transit Public-Private Partnerships

Guam already operates public transit services through an agreement with a private provider. With the acquisition of new vehicles and the development of a new maintenance facility, joint development opportunities may be available to help bolster funding for mass transit. For example, a private operator selected to operate the fixed-route services may be allowed to store and maintain their tourist services fleet if the operator is willing to pay a negotiated payment for the use of the federally funded facility. Funds collected in this manner could then be used to assist in meeting public transit operating and maintenance costs.

The Guam 2030 planning process identified many potential projects that could prove beneficial as transportation improvements for the island of Guam; however, 2030 revenue projections could not support inclusion of all of these projects in GTP at this time. As part of the endorsement of the GTP, the Government of Guam identified a subset of needed, but unfundable, transportation projects and established them as “illustrative projects.” Illustrative projects are identified in Table 6-6.

Illustrative projects are those projects that are considered high-priority and should be considered for inclusion into the transportation plan should additional revenue sources become available. Illustrative projects are not considered to be a part of the officially endorsed transportation plan.

Table 6-6: Anticipated Revenue for Guam Transportation Plan (2012–2030)

Guam 2030 Revenue Projections												
Funding Source	**Unexpended Previous Years***	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	
FHWA												
2006 American Samoa Loan Repayment	1,500,000			-	-	-	-	-	-	-	-	
Emergency Relief	12,255,937		-	-	-	-	-	-	-	-	-	
Territorial Highway Program	71,193,915	18,400,000	18,400,000	18,400,000	18,400,000	18,400,000	18,400,000	18,400,000	18,400,000	18,400,000	18,400,000	
Earmarks			4,600,000	6,400,000	3,000,000							
Village Streets												
Liquid Fuels Taxes & Registration Fees		1,897,247	2,212,504	2,232,445	2,232,445	2,272,326	2,292,279	2,320,299	2,348,318	2,376,338	2,404,357	
Department of Defense												
Defense Access Road Program		-	-	50,000,000	-	-	-	-	-	-	-	
Transit												
Local Operating Funds			3,100,000	3,100,000	3,100,000	3,162,000	3,225,240	3,289,745	3,355,540	3,422,650	3,491,103	
5310 (Elderly & Disabled)		145,000	147,000	148,000	150,000	153,000	156,060	159,181	162,365	165,612	168,924	
5311(a) & 5311(b) (Non-Urbanized & Rural Transit Assistance)		507,000	536,000	567,000	599,000	610,980	623,200	635,664	648,377	661,344	674,571	
5316 (Job Access/Reverse Commute)		85,000	89,000	89,000	89,000	90,780	92,596	94,448	96,336	98,263	100,228	
5317 (New Freedom)		23,000	23,000	25,000	26,000	26,520	27,050	27,591	28,143	28,706	29,280	
5309 Bus & Bus Discretionary Grant Application		297,000	5,000,000	20,000,000								
Total All Funding Sources	84,949,852	21,354,247	34,107,504	100,961,445	27,596,445	24,715,606	24,816,425	24,926,927	25,039,079	25,152,914	25,268,465	

Guam 2030 Revenue Projections													
Funding Source	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**Total**
FHWA													
2006 American Samoa Loan Repayment	-	-	-	-	-	-	-	-	-	-	-	-	-
Emergency Relief	-	-	-	-	-	-	-	-	-	-	-	-	-
Territorial Highway Program	18,400,000	18,400,000	18,400,000	18,400,000	18,400,000	18,400,000	18,400,000	18,400,000	18,400,000	18,400,000	18,400,000	18,400,000	368,000,000
Earmarks													
Village Streets													-
Liquid Fuels Taxes & Registration Fees	2,488,416	2,516,436	2,544,455	2,572,475	2,600,494	2,628,514	2,656,533	2,684,553	2,712,572	2,740,592	2,768,586	2,768,586	50,588,904
Department of Defense													-
Defense Access Road Program	-	-	-	-	-	-	-	-	-	-	-	-	50,000,000
Transit													-
Local Operating Funds	3,704,787	3,778,883	3,854,460	3,931,550	4,010,181	4,090,384	4,172,192	4,255,636	4,340,748	4,427,563	4,516,115	4,606,437	76,828,283
5310 (Elderly & Disabled)	179,264	182,849	186,506	190,236	194,041	197,922	201,880	205,918	210,036	214,237	218,522	222,892	3,717,498
5311(a) & 5311(b) (Non-Urbanized & Rural Transit Assistance)	715,860	730,178	744,781	759,677	774,870	790,368	806,175	822,299	838,745	855,520	872,630	890,082	14,845,207
5316 (Job Access/Reverse Commute)	106,363	108,491	110,660	112,874	115,131	117,434	119,782	122,178	124,621	127,114	129,656	132,249	2,205,715
5317 (New Freedom)	31,072	31,694	32,328	32,974	33,634	34,306	34,993	35,692	36,406	37,134	37,877	38,635	644,366
5309 Bus & Bus Discretionary Grant Application													25,000,000
Total All Funding Sources	25,625,763	25,748,529	25,873,191	25,999,785	26,128,351	26,258,928	26,391,555	26,526,275	26,663,129	26,802,160	26,943,386	27,058,882	**591,829,973**

*These funds have not been included as available funding because they are already allocated to projects in the FY2008–2011 TTIP.

6.5 Highest Priority Projects with Available Funding

Chapter 5, Needs Assessment (Unconstrained), presented all of the transportation needs identified for Guam at an estimated cost of nearly $1.59 billion to be funded with FHWA sources. This chapter lays out the revenue that is anticipated to be available for these projects in the future. This revenue amounts to roughly $350 million, less than one quarter of what is needed.

In order to provide a financially constrained GTP, the project evaluation criteria were applied to the project list to determine the highest priorities. To ensure that existing TTIP funding is being used on the highest priority projects, major roadway projects were prioritized in the GTP project list. Funding allocated for these TTIP projects was added to the available funds for fiscally constrained projects.

The highest priority projects with available funding are listed in Table 6-7 and shown in Figure 6-1. Figure 6-2 illustrates the performance of the transportation system after implementation of the highest priority projects. Table 6-8 summarizes the funding that is available for transportation improvements, the cost of projects currently programmed, and the remaining balance for other transportation improvements.

Table 6-7: Highest Priority Projects with Available Funding

Project Name	Project Limits	Project Description	Preliminary Project Cost
2012 to 2015 Improvements			
Route 10a (TTIP)	Route 1 to Airport	Widen from two to four lanes/sidewalks	$6.1
Route 7/Route 7a/Route 24		Reconfigure Y-intersection	$0.7
Route 1/Route 14 (ITC)		Additional turn lanes and development access	$1.2
Route 1/Route 30		Additional turn lanes	$1.2
Route 27 Ext (Hamburger Highway)	Route 16 to Route 1	Widen from two to four lanes/sidewalks	$16.2
Route 10a (TTIP)	Airport to Route 16	Widen from two/three to six lanes/sidewalks	$26.5
Miscellaneous safety/traffic operations			$6.0
2016 to 2019 Improvements			
Route 26 (TTIP)	Route 1 to Route 15	Widen from two to four lanes/sidewalks	$51.4
Route 2 (TTIP)	Route 2a to Erskin Drive	Safety/operational improvements	$11.2
Route 4 (TTIP)	McD to Route 10	Rehabilitate four lanes/shoulders	$28.7
Route 10/Route 15		Traffic signal modifications, signing, striping	$0.4
Route 1/Route 4		SB left turn lanes	$1.2
Miscellaneous safety/traffic operations			$6.0
2020 to 2023 Improvements			
Route 25 (TTIP)	Route 16 to Route 26	Widen from two to four lanes/sidewalks	$28.3
Route 16/Route 10a		Restriping, signage for additional turn lanes	$0.4
Route 1/Route 27a		Eastbound right-turn lane	$0.7
Route 1/Route 10a		Northbound right-turn lane	$1.2
Route 1/Route 27/Salisbury		Additional southbound left turn lane	$1.7
Route 1/Route 3		Additional northbound left-turn lane	$1.7
Route 1/Route 14a		Northbound/southbound right-turn lanes	$2.6
Route 16/Route 27		Additional turn lanes	$2.6
Miscellaneous safety/traffic operations			$6.0
2024 to 2027 Improvements			
Tijan Parkway	Route 10a to Route 8	Widen from two to four lanes/sidewalks	$53.6
Route 1/Route 16		Traffic signal modifications, signing, striping	$0.4
Route 1/Mansana		Signing, striping	$0.4
Route 4/Route 10		Additional southbound through lane	$0.7
Route 29	Route 1 to Route 15	Rehabilitate two lanes/shoulders	$5.0
Route 1	Route 14 (ITC) to Route 8	Rehabilitate six lanes	$25.4
Route 1/Route 28		Traffic signal modifications, signing, striping	$0.4
Route 16/Route 27a		Traffic signal modifications, signing, striping	$0.4
Route 1/Route 26		Traffic signal modifications, sign/stripe, and median	$0.7
Route 7a	Route 4 to Route 24a	Rehabilitate two lanes/sidewalks	$9.2
Route 14	Rnbt to Route 1 (ITC)	Rehabilitate four lanes	$9.7
Route 14b	Route 14 to Route 1	Rehabilitate two lanes/sidewalks	$3.3
Route 7a	Route 8 to Route 4	Widen from three to four lanes	$5.8
Miscellaneous safety/traffic operations			$6.0
2028 to 2031			
Route 7	Route 24a to Route 6	Rehabilitate two lanes	$6.7
Route 15 (Dairy)	Route 4 to Route 10	Rehabilitate two lanes/shoulders	$11.6
Route 1/St. John's Church		Minor street approach widening	$0.7
Route 1/Route 14 (N San Vitoris)		Additional northbound left-turn lane	$1.7
Route 10	Route 8 to Route 4	Rehabilitate four lanes	$26.4
Route 4	Route 2 to Route 4a	Rehabilitate two lanes/shoulders	$38.8
Miscellaneous safety/traffic operations			$6.0
Total			**$414.9**

Figure 6-1: Highest Priority Projects with Available Funding

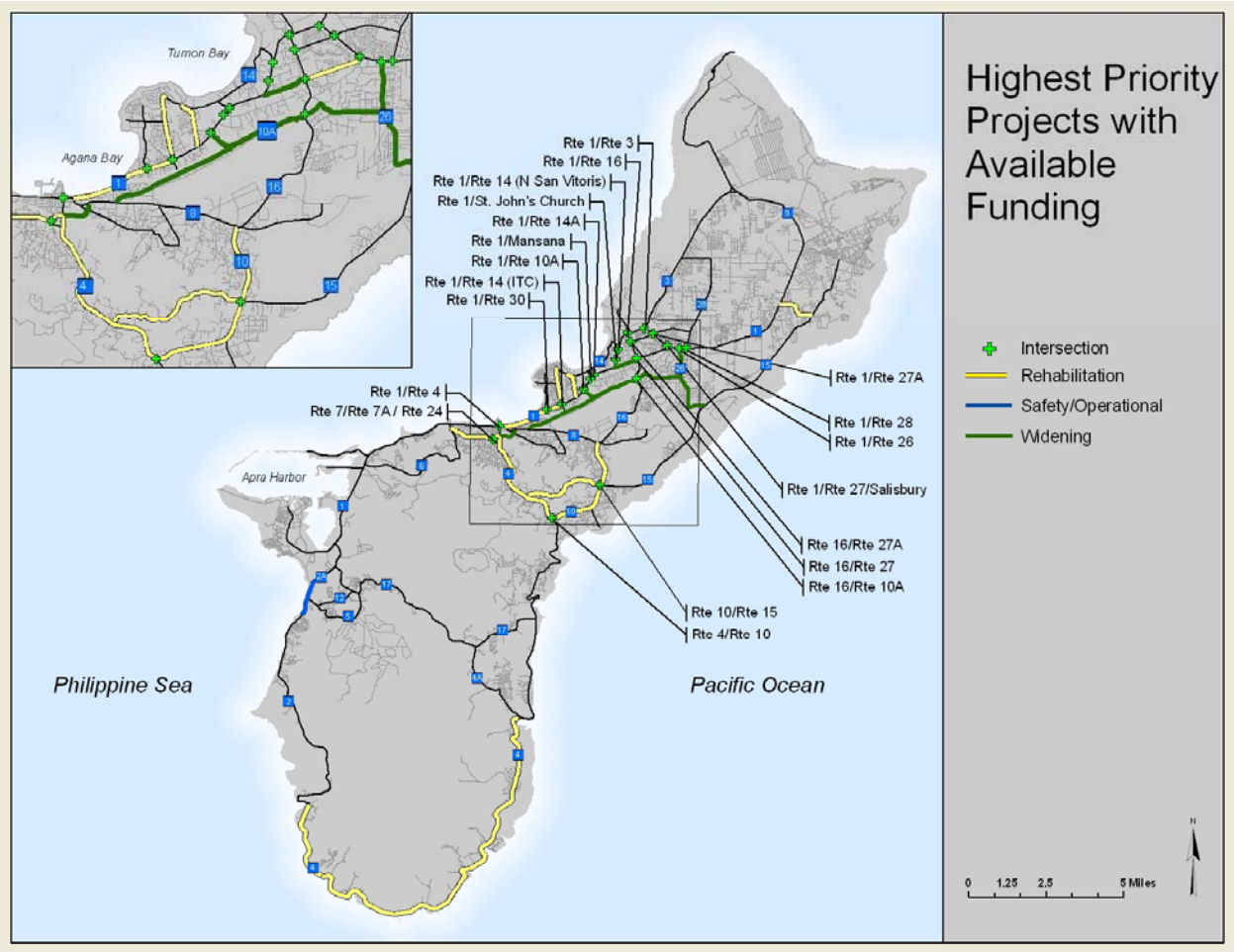

Figure 6-2: Performance of Transportation System with Highest Priority Projects

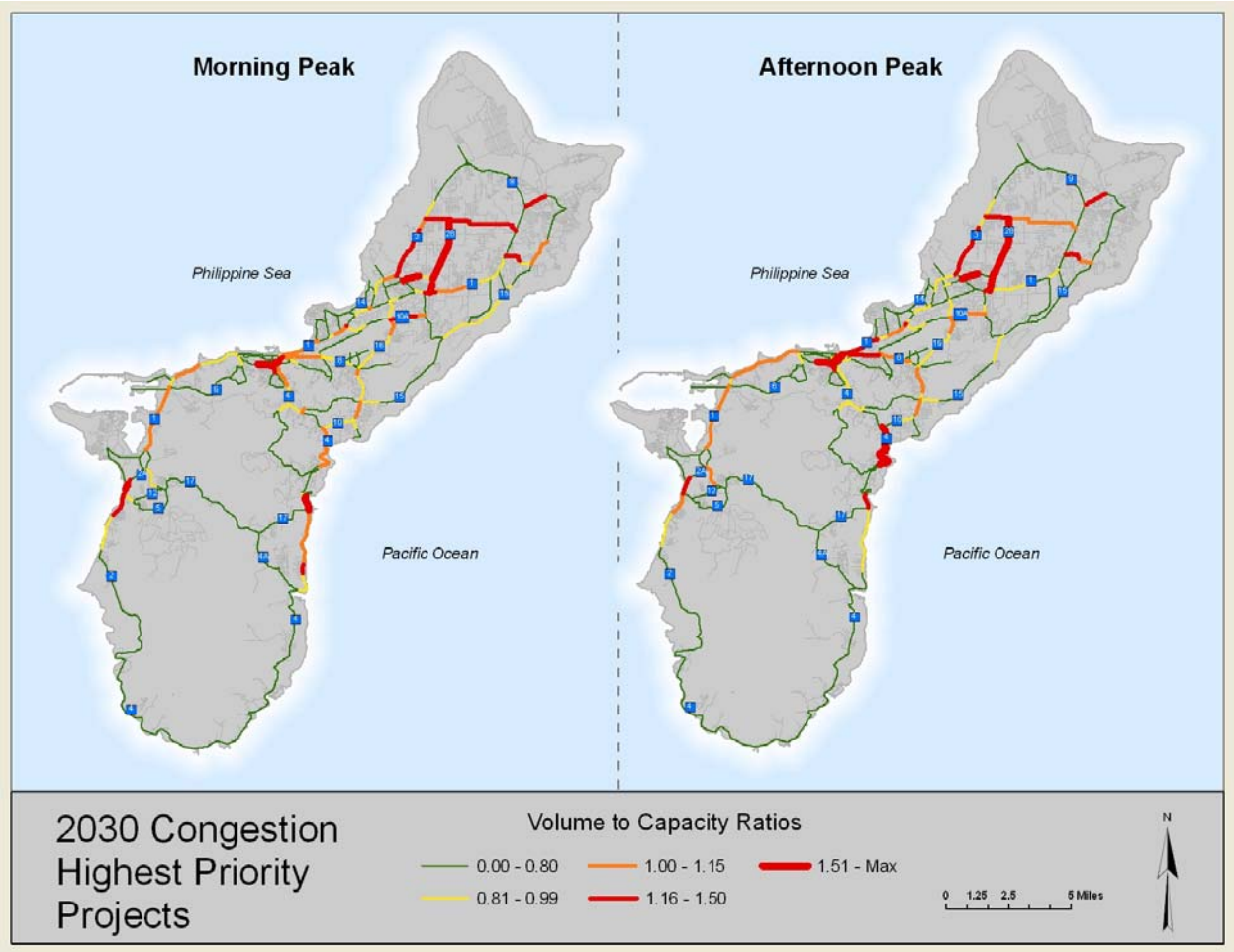

Table 6-8: Cost/Revenue Balance Sheet

Available Revenue*	
Territorial highway program	368,000,000
Village streets	50,588,904
Department of Defense	50,000,000
Transit	123,241,069
Total All Funding Sources	**591,829,973**
Projects Currently Programmed (list under development)	
Congestion relief	322,000,000
Village streets	50,588,904
Department of Defense	50,000,000
Transit	155,000,000
Bridge replacement	
Bicycle and pedestrian	
Traffic management	
Safety	
Reconstruction	
Enhancements	
Maintenance and preservation	
Total All Funding Sources	**577,588,904**
Balance	
Congestion relief**	46,000,000
Village streets	—
Department of Defense	—
Transit	(31,758,931)
Bridge replacement	
Bicycle and pedestrian	
Traffic management	
Safety	
Reconstruction	
Enhancements	
Maintenance and preservation	
Total All Funding Sources	**14,241,069**

*Assumes reasonable level of certainty that funding will be available.
**The balance of THP funding is shown under "Congestion Relief," however, these funds are available to be spent on a variety of projects (as listed) and will be allocated to each.

6.6 Conclusion

In summary, the transportation improvements identified in this plan represent a holistic, comprehensive, and integrated strategy that includes transportation systems management and travel demand management as well as roadway, mass transit, and pedestrian/bike elements. The plan is designed to provide Guam residents with a comprehensive and coordinated transportation system in both the short and long terms.

There are other transportation elements that are presently in various stages of development that will augment and strengthen the overall implementation of the GTP. These include the

development of Guam-appropriate rights-of-way policies and manuals, a holistic Asset Management System to ensure the proper coordination of public and private utilities, and standardization of road design and construction techniques and methodologies. The GDPW has already begun the process of implementing these elements through its Islandwide Program Management Services (IMPS) contract.

The IMPS includes the development and implementation of a TTIP that is a crucial element towards the realization of the GTP. The TTIP consists of a prioritized list of highway and transit projects that are advanced over four-year increments based on federal funding through the THP. Projects included in the TTIP are selected and coordinated from the GTP that is also designed to be updated every four years.

The transportation improvements proposed in this plan have been carefully selected based on existing conditions and state-of-the-art travel demand modeling techniques and includes input from all levels of Guam's citizenry. The plan takes into consideration Guam's potential growth patterns over the next 20 years as well as the impact of a potential surge in growth due to the anticipated military build-up. The plan also addresses natural, man-made, and fiscal constraints and represents a practical approach towards the realization of a transportation system that will foster economic growth and an improved quality of life for the people of Guam.

7.0 POLICY RECOMMENDATIONS

7.1 Institutional and Policy Recommendations

The purpose of this section is to provide an overview of a number of institutional and policy initiatives that will facilitate the planning process and delivery of projects on Guam. The recommendations contained in this section are the result of discussions with stakeholders, including GDPW staff, citizen groups, and the military.

7.2 Policy Initiatives

During the course of the GTP, issues pertaining to asset mapping, utility coordination, mass transit operation, and transportation and land use, as well as right-of-way, were identified as priority policy areas. This section describes recommended policy actions that will help GDPW and the Government of Guam deal with these matters.

7.2.1 Asset Mapping and Utility Coordination

One of the biggest challenges faced by Guam is the need to coordinate the planning of infrastructure with local utility companies. GDPW should engage in an on-going dialogue and analysis with the Guam Telephone Authority, Guam Water Works Authority, Guam Power Authority, and the Port Authority. Key elements that should be addressed include:

- Establishment of coordinating committee to include GDPW, Guam Telephone Authority, Guam Water Works, and Guam Power Authority
- Coordination and synchronization of construction of utilities and roads
- Use of geographic information system (GIS) tools to capture, store, display, and coordinate utility and road projects

The utility coordination committee should be established as a comprehensive working team to coordinate utility issues. The mission of this working group would be to synchronize construction of utilities in harmony with road construction. This group should consider using GIS technologies to identify conflicts between capital improvement programs and, thereby, minimize road cuts. The GDPW should investigate legislative action to impose fines, impact fees, and penalties for utility cuts of roads made by public or private developers.

7.2.2 Mass Transit

The Guam Mass Transit Authority should be re-created and should have the following legal functions:

- Own property
- Receive federal funds
- Enter into contracts
- Be governed by an independent board with the necessary powers to make decisions

In the interim, a working group that includes FHWA, FTA, and the Department of Administration—Division of Public Transportation Services should be formed. This group should move forward with funding capital assets with FTA-discretionary funding and secure a turn-key operator.

The Guam Mass Transit Authority should also be enabled to use procurement methods, such as best value and competitive negotiation, for major capital items such as vehicles and service contracts.

7.2.3 Transportation and Land Use

Coordinated transportation and land use decision making must be enhanced. The GTP recommends that the Territorial Land Use Commission (TLUC) and GDPW strengthen their partnership. Coordination between land development and roadway development should be a priority. The development community and investors should be encouraged to form public-private partnerships to facilitate the development and maintenance of roadways. Actions through the TLUC should focus on ways to enhance and capture value from the development community to pay for transportation improvements. Impact fees should be considered as a means of recognizing the impacts that land development has on the transportation system. The purpose and efforts of the TLUC should include:

- Joint development of land use and transportation plans
- Public-private partnerships for the develop and maintenance of roadways
- Consideration of impact fees
- Requirement of right-of-way dedications

7.2.4 Right of Way

As part of the TLUC process, rights-of-way dedications should be required of proposed developments for improvements to the roadway system. This is especially critical for intersection improvements, transit bus stop improvements, bicycle and pedestrian improvements, and roadway widenings.

7.2.5 Level of Service Standards

It is recommended that GDPW adopt LOS standards to guide the selection of transportation improvements. All intersections and roadway segments should operate at LOS E during peak periods. Improvements undertaken by GDPW would be designed to alleviate substandard LOS conditions to the extent feasible, with due consideration to physical and environmental constraints. Capacity improvements necessary to alleviate LOS deficiencies would be scheduled in the TTIP and constructed as funding allows. Roadway facilities should be limited to a maximum number of six through lanes—three through lanes in each direction.

7.2.6 Project Delivery Innovations

In order to most effectively implement improvements to the transportation system, new approaches to the project delivery process should be considered. Recommendations for methods to employ include:

- Utilizing design-build delivery
- Incorporating warranties to maximize private sector commitment to maintenance
- Forming public-private partnerships to design, build, operate, and maintain an expanded transit system
- Partnering with the U.S. Military for joint funding and delivery

7.2.7 Monitoring and Enforcement

A program of traffic monitoring should be developed to document the use of the HRN by military vehicles and construction vehicles. This monitoring effort would include traffic counts, weighing trucks, and enforcement efforts. This program would be designed to ensure that military and associated construction vehicles primarily use the HRN rather than local roads that are not engineered for a high level of heavy truck use.

7.3 Plan Approval Process

In order for the region to be eligible for federal funding consideration, Guam must have a federally approved long-range transportation plan. To achieve this approval, the GTP will undergo a process that results in recognition by the Government of Guam.

Upon completion of the draft GTP document, staff in the Department of Administration will publish the proposed plan and otherwise make it available to the public for review. Any comments received will be addressed in the final GTP. Once complete, the staff will submit the GTP to the Governor/Guam Legislature for formal adoption. Once recognized by the Government of Guam, the GTP will be submitted to FHWA for approval.

The GTP has an approximate 20-year horizon but is reviewed and updated at least every 5 years. Implementation of the projects identified in the GTP occurs every 4 years through the TTIP. The TTIP programs the use of federal and territory transportation funds for specific projects.

7.4 Plan Implementation

Implementation of GTP project recommendations requires a coordinated planning effort to forward funding priorities in each three- or four-year TTIP review cycle. It is recommended that a technical committee be developed that will coordinate with GDPW on the selection of projects from the GTP for funding in future TTIPs.

Best practices for plan implementation include the following:

- The plan approval process should involve a new advisory group at the technical level. The technical group would include staff from GDPW, FHWA, FTA, FAA, DOA, EPA, Department of Aviation, and representatives from Andersen Air Force Base, Navy Base Guam, and U.S. Marine Corps Finegayan.
- The plan implementation process should center on selecting projects from the plan and moving them into the TTIP. The TTIP will become the central focus for short-term decision making and priorities. The GTP will be the central focus for policy.

- The implementation process should focus on using resources from the private sector. The private sector should be relied upon to engage in discrete work elements, such as design, operations, and maintenance. The public sector should remain in control of policy and oversight.
- Coordination with the stakeholders must be effective. Stakeholders engaged for the GTP include the Department of Administration—Division of Transit, the JGPO, the U.S. Marine Corps, the U.S. Air Force, the U.S. Navy (Naval Facilities Command-Pacific and Marianas), and the TLUC. Each of these groups should be asked to sit on a technical committee to review project proposals, technical studies, and environmental documents and advise the GDPW on matters relating to the long-range plan, funding, and project administration.

7.5 Plan Amendment Process

The GTP may, from time to time, need to be amended. This is especially true for projects and programs that may be developed and administered during the military build-up. For example, the military may resurrect the notion of a connector road in the south. This project would need to be included in the GTP, and an amendment would have to be prepared. The plan should be amended to reflect:

- Major new projects
- New initiatives from the military
- Results from engineering and environmental studies

Amendments should emanate from the local level. GDPW working with the villages would develop the appropriate studies and justifications that would support a change in the GTP. Once these justifications are in place, GDPW, in conjunction with FHWA and FTA, would amend the plan to include a design concept and scope description and a cost and revenue estimate to ensure that the new amendment meets the fiscal constraint requirements. Once the project is shown to be fiscally constrained, the project would then be amended into the GTP.

Likewise, a project may be in project development (environmental clearance and preliminary engineering) and, during this phase a change would occur to the locally preferred alternative that would then need to be amended in the GTP. The new design concept and scope would be developed as above and, if determined to meet fiscal constraint, the project would be amended.