CHAPTER 6

TECHNICAL ASSISTANCE TO SRA ON ENVIRONMENTAL ISSUES

6. TECHNICAL ASSISTANCE TO SRA ON ENVIRONMENTAL ISSUES

6.1 Environmental and Social Considerations

6.1.1 Project Components

(1) Name

The Project for Construction of Mykolaiv Bridge in Ukraine

(2) Project Proponent

The State Road Administration of Mykolaiv in Ukraine (Ukravtodor Mykolaiv)

(3) Project Object

The aim of the planned activity is to construct a highway river crossing over the Southern Bug River of city Mykolaiv cit;y. A highway river crossing including the bridge and approaches to it on the road M-14 Odessa – Melitopol – Novoazovsk (to Taganrog): beginning on the right bank of the Southern Bug River near the village Vesniane from M-14; end – on the left bank to the M-14 at the crossing with auto road P-06 Ulianovka – Mykolaiv. Construction of approaches to the bridge structures requires allocation of land for permanent use within the projected band allocation of the road. At present these lands are owned by individuals and legal entities.

(4) Location

Ukraine is located in Eastern Europe and is surrounded by seven countries; Romania, Moldova, Slovakia, Hungary, and Poland in the west, Belarus in the north, and Russia in the east, as well as the Black Sea in the south. In order to exploit this geographical position, the Government of Ukraine established the “Comprehensive Program for Consolidation of Ukraine as a Transit Country for 2002-2010”, which was indicative of the importance attached to establishing international trunk roads providing new traffic systems for cross-border logistics. The current trunk road development plan in Ukraine is based on this Program. The project site is shown in Figure 6.1.1.

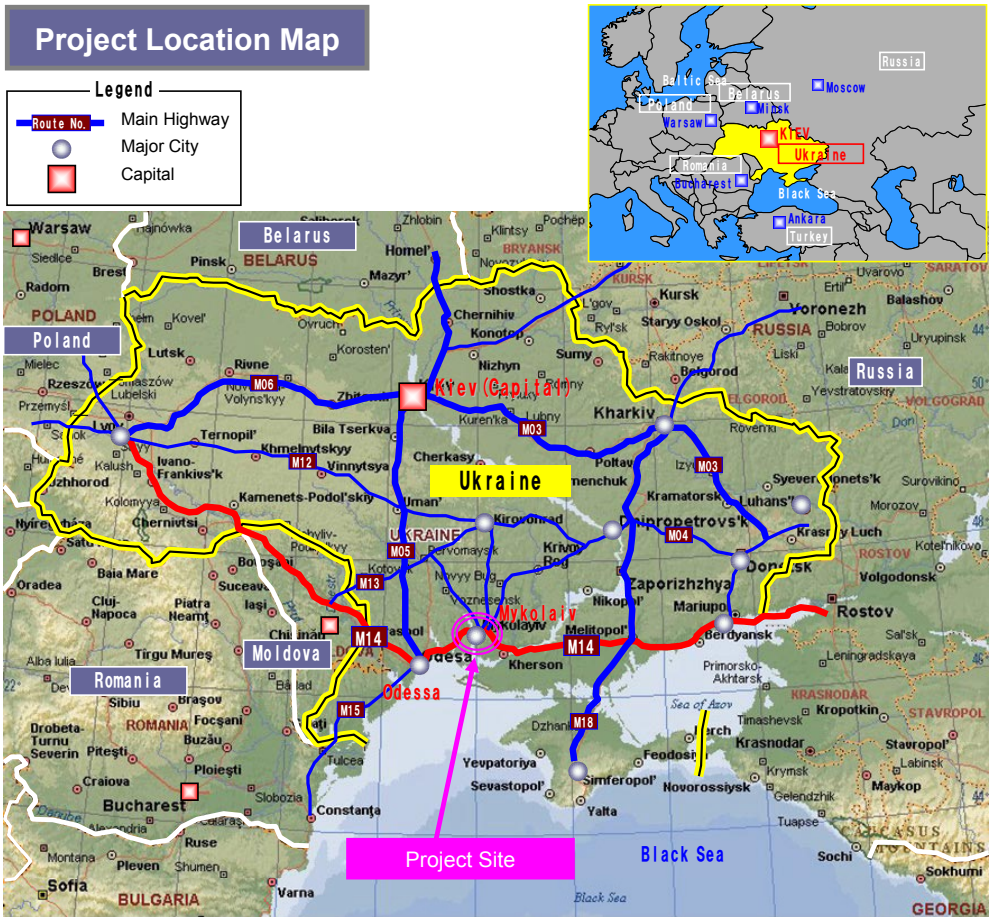
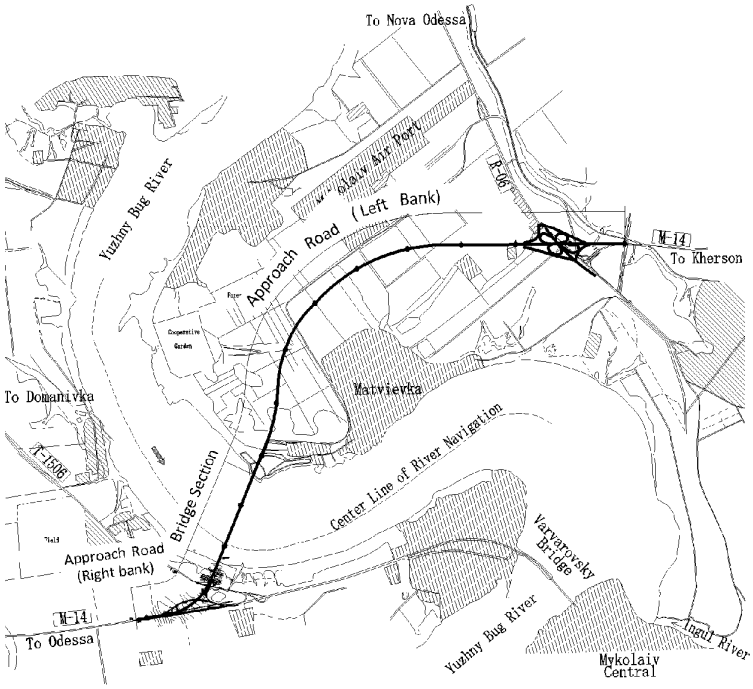


Figure 6.1.1 Project Site

Location of project roads and Bridge section is shown in Fig 6.1.2.



Source：JICA Survey Team

Figure 6.1.2 Location of the Road (M-14 Bypass Road)

(5) Project Components and Estimated Construction Cost

Project components and estimated cost are as follows.

- Left bank ····· PK 0 - PK 95+70 ========== 9.57km
- Bridge section ····· PK 95+70-PK116+20 ========== 2.05km
- Right bank····· PK 116+20 - PK131+92.987 ====== 1.57km
- Construction cost····· Refers to Table 9.3.1 Result of Cost Estimation.

(6) Technical and Economical Justification for the Construction

The road M-14 is one of the most important trunk roads in the Ukraine, connecting the western border (with Romania and Moldova) and the eastern border (with Russia) through cities in southern Ukraine, such as Odessa and Mykolaiv. M-14 is also a part of the international corridor of the Black Sea Economic Cooperation (BSEC). However M-14 suffers serious traffic jams because of the number of heavy vehicles, even transit cargo, that must pass through the downtown of Mykolaiv city and negotiate the existing swing-bridge (Varvarovsky Bridge).

In order to solve the above problems, the Government of Ukraine planned the M-14 bypass project to provide a detour around the downtown area of Mykolaiv. However, the project for the new bridge across the Southern Bug River (Mykolaiv Bridge) has not been started because of lack of funds, consequently all vehicles must still pass over the existing swing-bridge to cross the river in Mykolaiv.

In 2005, the Government of Ukraine requested Japan to apply a Yen Loan for the Mykolaiv bridge project (hereinafter referred to as “the Project”). In response to this request, the Government of Japan sent the TOR Mission to Ukraine and agreed to the scope of the “Preparatory Survey on the Project of Construction of Mykolaiv Bridge in Ukraine” (hereinafter referred to as “the Survey”), as stated in the Minutes of Meeting of August 5, 2010. According to the minutes, the preparatory survey was started on November 10 in order to review and update the Feasibility Study Report for the Mykolaiv Bridge undertaken in 2003. The analysis of alternatives takes into account social and environmental conditions and economic factors.

The result was agreed in the manner prescribed for Highway Bridges. In agreement with the previous decision the route of the bridge was decided based on a promising route proposed in "The general plan Mykolaiv city", which was approved in 2007. The local authority reserved strip land to be acquisitioned for the construction. Currently, the land which fell in the border zone for use by natural and legal persons, is reserved for construction. To implement the planned construction these lands should be acquired from the current owners and transferred to the proponent of the construction.

6.1.2 Baseline of Environmental Condition

6.1.2.1 Ecological Condition

(1) Common Flora Species

Common flora species around the project are is shown in Table 6.1.1.

Table 6.1.1 Common Flora Species around Project Area

No	Habitats (example)	Wild species	Planted species
1	Canal and river corridors	Potamogeton L. (rdesnyk), Phragmites australis L. (reed)	Absent
2	Residential and garden land	Stipa lessingina (feather grass Lessing), S. pontica (Black Sea feather grass), S. ucrainica (feather grass ukrainian), Festuca valesiaca (sheep fescue), Ambrosia artemisiifolia* (ragweed)	Vegetables, for example. Potatoes, tomatoes, flowers, fruit trees, for example. apple, cherry
3	Paddy field		
4	Forest	Quercus robur (Oak tree), Ulmus (elm tree), Acer (maple), Fraxinus (ash tree), Robinia (acacia)	Scotch pine (Pinus sylvestris)

Source:

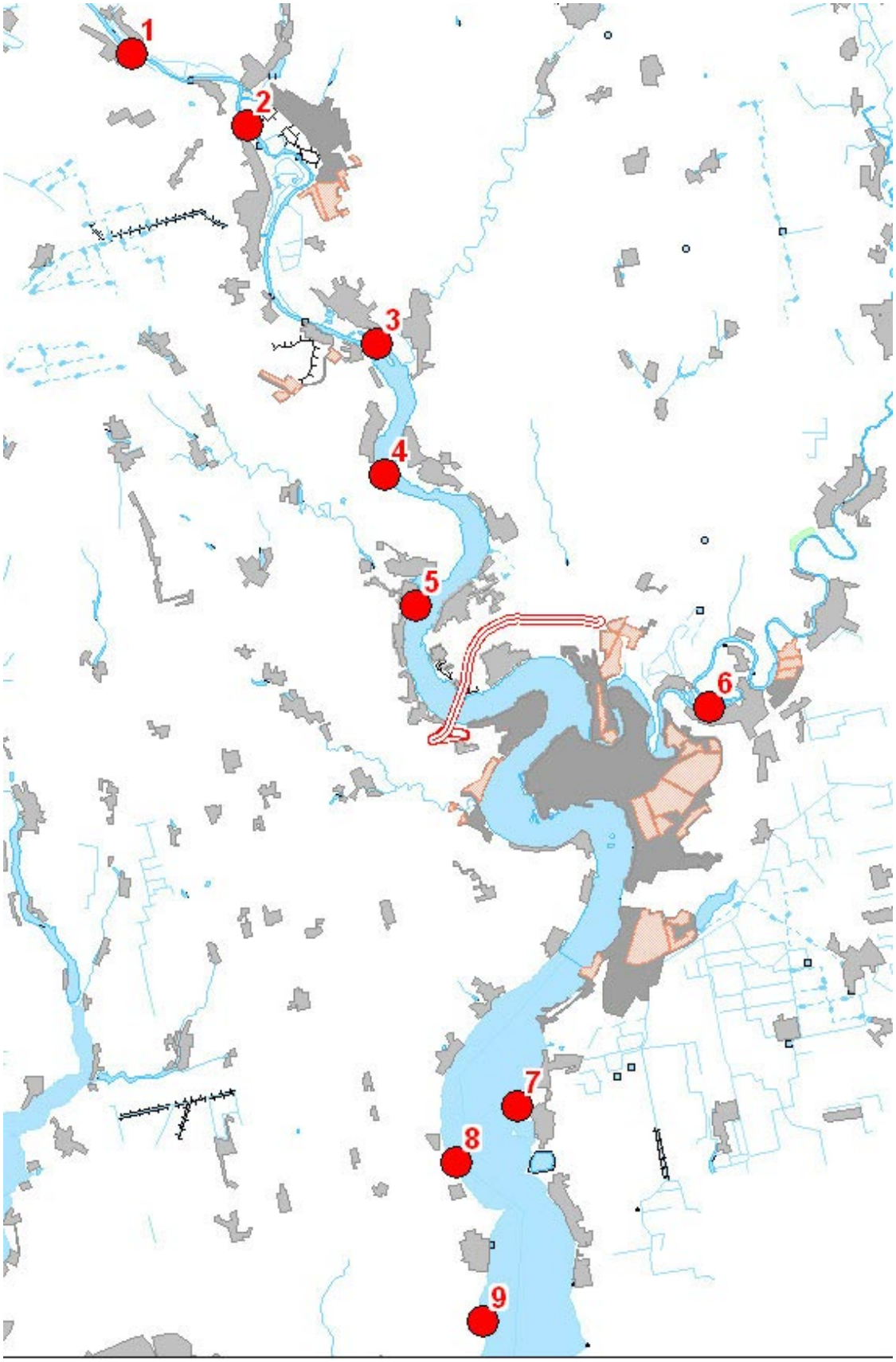
1. National Atlas of Ukraine (electronic version, second edition) that was prepared by the National Academy of Sciences of Ukraine (NASU), with the scientific and methodological support of the Institute of Geography NASU-2007.
2. "Southern Bug Mediterranean ecological corridor: a brief overview of biodiversity and the most valuable territory" under the general editorship of V. Kostiushyna. International Wetlands of Black Sea Program. Kyiv - 2007.
3. T.L. Aleksenko, A.A.Solohyb Effect of dredging on benthos invertebrates of the Dnieper-Bug lagoon – 2006

Table 6.1.2 gives plant species characteristic of the natural conditions of the territory. Sampling location is shown in Figure 6.1.3.

This area is under strong anthropogenic influence. Since the 50s of the last century natural land was pressured due to economic use and, at present, primitive habitats are extinct. Covered areas represent monoculture artificial plantation pine – the kind that is not typical for a given bio climatic zone. The areas of arable farmland are used for growing vegetables, perennial crops and so on. Water bodies (lagoons), over the past 100 years, have been damaged substantially by man-made pollution as a result of discharges of industrial waste waters, in addition 25-30% (depending on water content of the year) of the flow of the Southern Bug River is used to irrigate farmland and for industrial Water supply, which causes the increase of salt water in the lagoon. These factors have led to a significant depletion of aquatic flora, among which now occupies a dominant position rdesnyk (Potamogeton).

Conclusion: any construction in the territory that is affected by the project now will not lead to the losses of natural biodiversity.

The following Figure 6.1.3 and Table 6.1.2 show some locations of studies of flora and aquatic organisms and comment on the specific types of vegetation according to the surveyed points. In the area around the project nothing on the Red data list was found. (Ukraine Red book, flora. August 2005)



Source: The Southern Bug meridional river corridor biodiversity and valuable areas.(2007)

Figure 6.1.3 Location Maps of Alien (Artificially Listed) Species

Table 6.1.2 Flora and Aquatic Organisms

Point	Description of flora and aquatic organisms and comment on the specific types of vegetation
1:	Artificial forest plantations Pinus sylvestris and Robinia pseudoacacia under the age of 40.
2:	Aquatic vegetation is dominated by associations formed of types of broad ecological amplitude - Potamogeton pectinatus, P. perfoliatus, Najas marina, Ceratophyllum demersum. Large areas are dominated by groups of water relicts - Nymphaea alba, Nuphar lutea, Trapa natans, Salvinia natans, Nymphoides peltata. Also playing an important role of air-aquatic vegetation, are Phragmites australis, Typha angustifolia, Scirpus lacustris. In the grassy marshes are the most common associations of Phragmites australis - Carex acuta, Phragmites australis - Carex riparia, Typha angustifolia - Carex acutiformis, Carex acuta pura. Earth moss features that prevail are meadow marshes and meadow plants, represented by groups dominated by Glyceria maxima, Carex acuta, Agrostis stolonifera, Festuca pratensis, Elytrigia repens, etc. In floristic respects are characterized by a large number of boreal meadow species - Agrostis gigantea, Alopecurus pratensis, Beckmannia eruciformis, Poa palustris, Carex vesicaria, Lathyrus palustris.
3:	Large areas of rocky steppes dominated in the vegetation formations such as Festuceta valesiaceae, Thymeta dimorphii, Koelerieta brevis, and more on the prevailing soil - endangered groups Stipeta lessingianae and Stipeta capillatae. The basis of the floristic complex is typical of limestone outcrops Koeleria brevis, Jurinea brachicephala, Paronychia cephalotes, Centaurea marschalliana, Dianthus pseudoarmeria, Astragalus ucrainicus, A. albidus and A. odessanus. Among the species listed in the Red Book of Ukraine, there are: Stipa capillata, S. lessingiana, Genista scythica, Cymbochasma borysthenica, Caragana scythica, Chamaecytisus graniticus, Tulipa hypanica, Bulbocodium versicolor, Crocus reticulatus.
4:	The common native prairie and tree-shrub communities exist with the participation of a large number of rare, endemic and relict plant species. In particular, found eronica gryniana are found; also fragments of rare and endangered formations of Stipeta dasyphyllae; unique combinations of floral complexes southern desert sand and limestone outcrops, that are home to: Stipa borysthenica, Allium guttatum, Scabiosa ucrainica, Achillea ochroleuca, Onosma borysthenica, Jurinea charcoviensis and Thymus dimorphus, Teucrium polium, Festuca valesiaca, Linosyris villosa, Ephedra distachya, Tulipa hypanica and more. Under state protection are: Crocus reticulatus, Gymnospermium odessanum, Ornithogalum boucheanum, Pulsatilla nigricans, Stipa capillata, S. lessingiana, S. ucrainica, S. grafiana, S. asperella, S. dasyphylla, S. borysthenica, S. disjuncta, Tulipa hypanica.
5:	There is a unique range of floral southern sandy steppe-types the indicator of which is the pearl cornflower of Margaritaceae kind. Within the tract is one of the two habitats on the planet of Centaurea margaritacea, a species listed in IUCN Red List, the European Red List and Red Data Book of Ukraine.
6:	In the tree-shrub thickets right bank of the river there is a marked increase of Fritillaria ruthenica, that is in the Red Book of Ukraine.
7:	Lawns remain of the sandy Black Sea steppe dominated by herbaceous cover with Carex colchica, Artemisia marschalliana, Festuca beckeri, Koeleria sabuletorum, Thymus pallasianus, occasionally Stipa borysthenica. As part of this floristic complex grows a significant number of rare, endemic and relict plant species under the state protection. There is only one of the world's population of Centaurea protomargaritacea - endemic sand of the Lower Bug region, registered in the Red Book of Ukraine.
8:	Common Native phyto ceonosises, true desert and steppe species, spread over the area (Festuceta valesiaceae, Stipeta capillatae, Stipeta lessingianae, Agropyroneta pectinatae, Kochieta prostratae, Artemisieta santonici), and intertidal communities exist with the participation of Astragalus borysthenicus and Astrodaucus littoralis.
9:	At the coastal breakages and pakora preserved remains of indigenous groups and the true desert steppe (Festuceta valesiaceae, Stipeta capillatae, Stipeta lessingianae, Agropyroneta pectinatae, Kochieta prostratae, Artemisieta santonici are found.

Source: The Southern Bug meridian river corridor biodiversity and valuable areas.

(2) Common Wild Animal Species

Common wild animal species around the project area is shown in Table 6.1.3.

Table 6.1.3 Common Wild Animal Species around Project Area

	Habitats (example)	Mammal	Avian	Reptilian and amphibians
1	Canal and river corridors	Eurasian water shrew (Neomys), water vole (arvicola terrestris), river otter (Lutra)	harrier (Circus), heron (Egretta), sandpiper (Haematopus), cormoran (Phalacrocorax), seagul (Vanellus)	tortoise (Emus orbicularis), water snake (Natrix tessellata), frog (Rana)
2	Residential and garden land	field mouse (Apodemus agrarius), vole (Microtus), hedgehog (Erinaceus), mole (Talpa)	crane (Anthropoides), lark (Alauda), sparrow (Passer), crow (Corvus)	spade-footed toad (Pelobates), lizard(Lacerta), water snake (Natrix)
3	Forest	ferret (Mustela), forest vole (Sylvaemus sylvaticus), hedgehog (Erinaceus), fox (Vulpes)	vulture (Milvus), woodpecker (Dendrocopos), black-billed magpie (Pica pica), rook (Corvus),	lizard (Lacerta), racer (Elapha), smooth snake (Coronella)

Source:

1. National Atlas of Ukraine (electronic version, second edition) which was prepared by the National Academy of Sciences of Ukraine (NASU) with scientific and methodological support of the Institute of Geography NASU-2007.
2. "Southern Bug Mediterranean ecological corridor: a brief overview of biodiversity and the most valuable territory" under the general editorship of V. Kostiushyna. Wetlands International Black Sea Program. Kyiv - 2007.
3. T.L. Aleksenko, A.A.Solohyb Effect of dredging on benthic invertebrates of the Dnieper-Bug lagoon-2006

In the earth moss of the Southern Bug River are found not less than 45 species of birds, which form clusters of 3 to 5 thousand individuals exist. The representatives of the avifauna of the area are Podiceps cristatuis, Ixobrychus minutus, Nycticorax nycticorax, Egretta alba, E. garzetta, Ardea cinerea, A. purpurea, Anas platyrhynchos, Aythya ferina, Fulica atra, Vanellus vanellus, Philomachus pugnax, Gallinago gallinago, Larus ridibundus, Chlidonias hybrida, and Riparia riparia. In the absence of natural habitats in the area of construction, the majority of listed species in the table are presented as such, which could potentially have their area of distribution on the given territory. In fact, one can state that there is an absence of wild fauna.

According to the information collected by Ukrpromindustriya species on Red data list was not found in the Project site. (Ukraine Red book, fauna. August 2005)

(3) Common Fish

Common fish in the Southern Bug River around the project area are shown in Table 6.1.4.

Table 6.1.4 Common Fish in the Southern Bug River (+ Existing in that area) * Introduced (Artificially Populated) Type

No.	scientific name	local name	Upper stream	Southern Bug Lagoon	Lower stream (brackish)
1	Gobiidae	goby		+	+
2	Clupeonella	whitebait		+	+
3	Ctenppharyngodon idella*	white amur		+	+
4	Abramis	bream	+	+	+
5	Ratilus rutilus heckeli	array	+	+	+
6	Sander	zander	+		
7	Cyprinus	carp	+		
8	Carassius	crucian	+	+	+
9	Esox	pike	+	+	+
10	Silurus	catfish	+		
11	Clupea	herring			+

Source:
1. State Department of Environmental Protection in the Mykolaiv region "Regional report on the state of the environment in the Mykolaiv region in 2008"
2. V. M. Smirnov "Formation of field contamination of bottom sediments of Bug lagoon by heavy metals." Thesis for Ph.D. degree in geological sciences. Kyiv - 2010.

Over the last 50 years in the Dnieper-Bug estuary present 79 living fish species, forming 20 families were permanently or temporarily present. Carp were the most representative (26 kinds) - roach, carp, dace, chub, Dnieper bobyrets, ide, rudd, chub, oatmeal, tench, Podust, gudgeon, barbel Dnieper, Danube shemaya, bleak, Russian bystryanka, silver bream, bream, klepets , zope, vimba, sabrefish, bitterling, golden and silver carp, common carp, gobies (16 species), perch (7 species - walleye, Boersch, sea perch, grouper, Black Sea perkarina, ruff, Nosar), sturgeon (5 species) - beluga, sturgeon and herring (4 types) - Black Sea-Azov herring, Black Sea shad, black sea sprat, the Black Sea and Azov kilka.

Currently, the dominant species are less sensitive to the poor environmental situation, especially goby and kilka.

According to the information collected by Ukrpromindustriya species on Red data list was not found in the Project site. (Ukraine Red book, fauna. August 2005)

(4) Benthic Macro Invertebrates

Name of Benthos confirmed in the literature is shown Table 6.1.5.

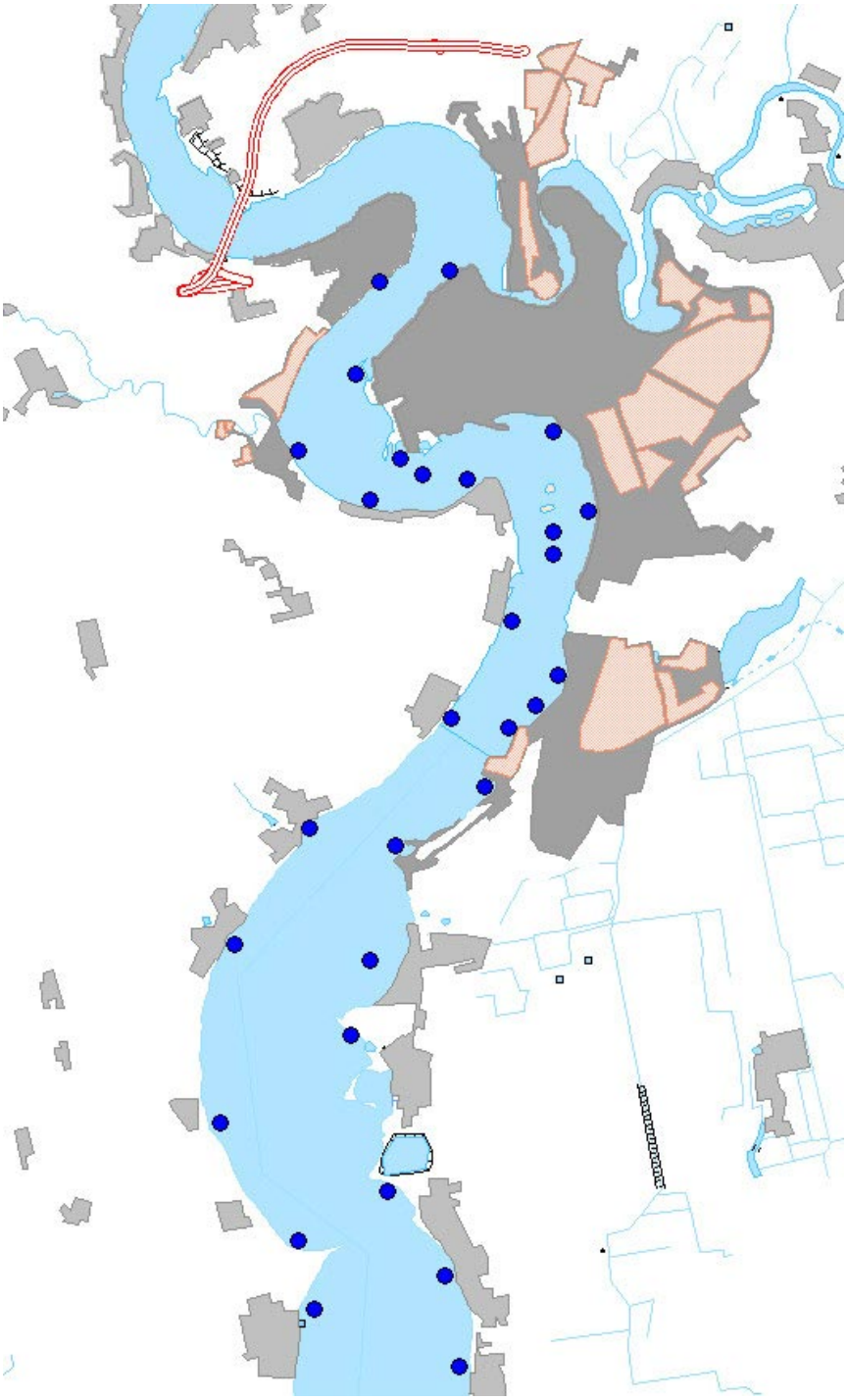
Table 6.1.5 List of Benthos

No.	Name	Type	remark
1	chironomids	*Chironomus plumosus* L.	One of the most widespread
2	Marine polychaete worms	Nereis diversicolor та N. succinea	
3	Hydrobionts (aquatic organisms)	Mollusks of kind Turricaspia, Dreissena, Theodoxus	
4	polychaete	*Hypaniola kowalewskii*	
5	cumaceans	*Pterocuma pectinata*	

Source:
1. "Southern Bug meridional ecological corridor: a brief overview of biodiversity and the most valuable territory" under the general editorship of V. Kostiushyna. Wetlands International Black Sea Program. Kyiv - 2007.
2. T.L. Aleksenko, A.A.Solohyb Effect of dredging on benthic invertebrates of the Dnieper-Bug lagoon-2006
3. V. M. Smirnov "Formation of field contamination of bottom sediments of Bug lagoon by heavy metals." Thesis for Ph.D. degree in geological sciences. Kyiv - 2010.

According to the information collected by Ukrpromindustriya species on Red data list was not found in the Project site. (Ukraine Red book, fauna. August 2005)

Sampling locations during the study for the PhD are shown in Figure 6.1.4.



Source: V. M. Smirnov "Formation of field contamination of bottom sediments of Bug lagoon by heavy metals." Thesis for Ph.D. degree in geological sciences. Kyiv - 2010.

Figure 6.1.4 Sampling Locations

(5) Natural Reserve and Cultural Assets

According to the information collected by Ukrpromindustriya in 2011 natural reserves and/or registered cultural assets was not found in the Project site.

(Source: SHORT ENGLISH VERSION of the NATIONAL REPORT OF UKRAINE ON CONSERVATION OF BIOLOGICAL DIVERSITY).

6.1.2.2 Pollution

(1) Environmental quality standards

Environmental quality standards for noise, air pollution and surface water are defined based on Part VII Standardization and Rating in the Field of Environmental Protection of the Environmental Protection Law. The Rating norms are shown from Table 6.1.6 to Table 6.1.8.

Table 6.1.6 Standards (MAL: Maximum Allowable Level) of Noise Level

Category	Average dB(A)		Max dB(A)		Normative documents
	Day	Night	Day	Night	
Residential and public buildings	55.0	45.0	70.0	60.0	SN 3077-84, SBN 360-92, SBN Б.2.4-1-94, ДСП 173-96
Buildings and prevailing construction (+5 dB(A))	60.0	50.0	75.0	65.0	SNiP II-12-77, SN 3077-84
	60.0	50.0	70.0	60.0	DBN 360-92**
*1 story of construction in vehicle impact zone (+10 dB(A))[1]	65.0	55.0	80.0	70.0	SN 3077-84, annex № 16 DSP 173-96
11 stories of construction (in process) in vehicle impact zone (5+10 dB(A))	70.0	60.0	85.0	75.0	SNiP II-12-77, SN 3077-84, annex № 16 DSP 173-96

* Standards (MAL) of this category apply to assess the traffic noise level caused by the project.

Source: The main regulatory documents: State public health rules DSP 173-96 Public health planning regulations and development of human settlements, and:DBN 360-92** "City Planning. Planning and development of urban and rural settlements"; SN 3077-84 03.08.1984sanitary standards allowable noise in residential areas and public buildings and in residential development.

Table 6.1.7 Standards (MAC: Maximum Allowable Concentration) for Air Pollution

Substance	Maximum allowable concentration (mg/m^3)	
	Maximum at one time	Daily average
Dust(Soot)	-	0.15
SO_2	-	0.5
CO	5	3
NO_2	0.085	0.04
NO	0.4	0.06

Source; “State sanitary rules of the atmospheric air protection (against contamination by chemical and biological agents) in residential areas”, No.201 dated 09.07.1997

[1] For noise generated by means of road transport in determining the maximum allowable equivalent and maximum noise levels applied corrective amendment + 10 dBA.

Table 6.1.8 Standards (MAC: Maximum Allowable Concentration) for surface water quality

Item	***MAC**(mg/L)
Dissolved oxygen	**>4–6**
Chlorides	**< 300**
Sulfates	**< 100**
TDS	**< 1000**
BOD (5 days)	**< 6.0**
Ammonium nitrogen	**< 0.50**
Nitrite nitrogen	**< 0.08**
Nitrate nitrogen	**< 40**
Phosphorus	**< 0.17**
Hexavalent chromium	**<0.005**

Source: "Sanitary rules and regulations of the surface water protection against pollution", No.4630-88 dated 04.07.1988

(2) Surface Water Quality

The surface water characteristics observations were executed by the Ukrainian Hydro meteorological service, Department of ecology and natural resources in Mykolayivs'ka oblast' and the Institute of environmental geochemistry at the Southern Bug River and Bug lagoon. Observed average values in ration to the corresponding MAC (Maximum allowable concentration) in 2008 are shown in Table 6.1.9. The locations of sampling point are shown in Figure 6.1.5.

The area surrounding the Bug Lagoon (the name is used for downstream sector of the River lower part under Nova Odessa) belongs to the steppe landscape-geochemical region of the Ukrainian Shield and includes a part of its territory within the steppe zone or rather its north subzone.

The heterogeneous content of carbonates and gypsum in the sedimentary rock jointly with the arid climate cause the high amount of total dissolved solids (TDS) of the surface and subsurface waters (up to 3.5 mg/dm^3) and variability of their chemical composition.

The chemical composition of water in the Bug lagoon is formed mainly under the influence of the tertiary marine sediments, which are strongly increasing the rate of TDS.

The change of the chemical composition of the lagoon's water depends on the dominance of waters of the different genetic classes (the surface-hill slope, surface-subsurface and subsurface waters) in the river runoff.

The rate of pH in the waters of the Southern Bug River widely varies from 7.70 to 9.25 and it is 8.70 in average. The near-bottom waters are characterized by the lesser rates.

The waters of the Bug lagoon are characterized by the large variability of the rates of chemical composition in comparison with the waters of the channel reaches (in the cross-section near Nova Odessa) because of the wind-induced surging. In Mykolayivs'ka oblast' TDS in the waters of the Southern Bug River gradually increases downstream, but average annual rates of TDS don't exceed maximum allowable concentrations (MAC) upwards of the area of the influence of sea waters. The rate of TDS could exceed the maximum allowable concentrations by 2-6 times in the waters of the lagoon. The situation with the content of sulfates and chlorides is the same: the concentrations of these anions often exceed the MAC because of mixing of the river and sea waters.

The content of dissolved oxygen in the waters of the mouth of the Southern Bug River and the Bug lagoon is quite irregular: the concentration of oxygen in the superficial layer in winter and spring is close to the saturation rate, but in the summer-autumn period the concentration sharply falls and reaches extremely low rates.

The content of ammonium in the waters of the Bug lagoon doesn't appreciably differ from its content in the channel part of the river. The average annual values of its concentration are 0.2-0.5 of the MAC in the waters of the channel part and for the most part 0.4-0.8 of the MAC in the waters of the lagoon (although there were considerable excesses in some sampling points, mainly downstream of Mykolayiv; no.15 and no.16).

The difference in the concentration of nitrites in the waters of the channel part and the lagoon is more appreciable but the excesses over the MAC are partial (as well as the concentrations of ammonium). The values of nitrites in the lower part of the Bug lagoon are almost equal to in the area of Nova Odessa. The values of nitrates in the waters of the channel part of the Southern Bug River and the Bug lagoon do not differ.

The content of phosphates in the waters of Bug lagoon reaches 2 times of the MAC, which is higher than the concentration in the channel part of the river. The largest excess of concentration of phosphates over the MAC (30 times) at the no.15 is observed near the Glicinove village. The average annual concentration of phosphorus in the waters of the lagoon in the observation period is exceeding MAC.

The concentration of petrochemicals at Nova Odessa was quite high value. The change of the ratio to MAC of petrochemicals was distributed from 0.2 to 2.4 times, which were observed between the Varvarovka village and the discharge point of heat-exchange waters of the affiliate of "Black Sea shipbuilding yard" ("BSSY"). The increase in the concentration of the petrochemicals in the water at this reach is observed every year.[2]

Most probably this is explained by the fact that in this reach of the river the affiliate of the shipbuilding yard, the sea port and the main municipal waste water discharge point (from the most asphalted areas of the city) all exhaust into the river.

However the concentration of surfactants in the waters of the channel part of the Southern Bug River is greater than their concentration in the waters of the Bug lagoon. But even in the cross-section near Nova Odessa average annual concentrations of surfactants is lesser than the MAC in a few times.

The main activity of the shipbuilding facilities of Mykolayiv is directly related to metal working so the main indicator of pollution of water bodies is a total concentration of iron. The value of total concentration of iron near Varvarovka reaches 1.8 to 3.2 of MAC because of mixing of waters of the South Bug and the Ingul Rivers. The shipbuilding yard "61st communard" is situated near the influx of the Ingul.

The content of organic substances in the water is an important characteristic of water quality. It is characterized by the biochemical oxygen demand (BOD) – an amount of oxygen that is consumed per specified period for aerobic oxidation (reduction) of the unstable organic substances contained in the water.

According to the criterions of environmental safety, the critical indicators regarding pollution of surface waters in the Bug lagoon are the content of petrochemicals, dissolved iron and BOD. The temporal and spatial time history of these indicators are characterized by the large

[2] Smirnov V.M., Kravtsova T.M. The environmental indicators of condition of surface waters of the Bug estuary in the borders of urban agglomeration of Mykolayiv // The collection of scientific publications of Institute of the environmental geochemistry. – 2007. – Vol.14. – pages 129–135

variability (more than 10 times). The above data must be useful material to understand that the concentration of pollutant is related to the location of anthropogenic facilities, conditions and characteristics of their work. Around the South Bug River, the upstream of the project site is relatively clean, and the downstream of the project site near the existing industrial facilities such as the shipbuilding industry (point no. 5 and 6), aluminum plant (point no. 18) and outlet of sewage treatment facilities (point no. 15) are relatively polluted.

These monitoring data for the surface water qualities are available to assess the impact on the bridge construction project not only during construction stage but also during operation.

The volumetric activity of radio nuclides in the waters of the Southern Bug River near Mykolayiv in the last years varies within the range of perennial values and it was close to pre-disastrous level. The average annual concentration of strontium-90 in 2010 is 10.2 Bq/m3, cesium-137 – 0.88 Bq/m3 (in 2009 respectively 10.0 and 0.9 Bq/m3). These values are much less than the standard which is determined in the "Allowable level of content of radio nuclides cesium-137 and strontium-90 in the provision and drinking water" (PL-2006).

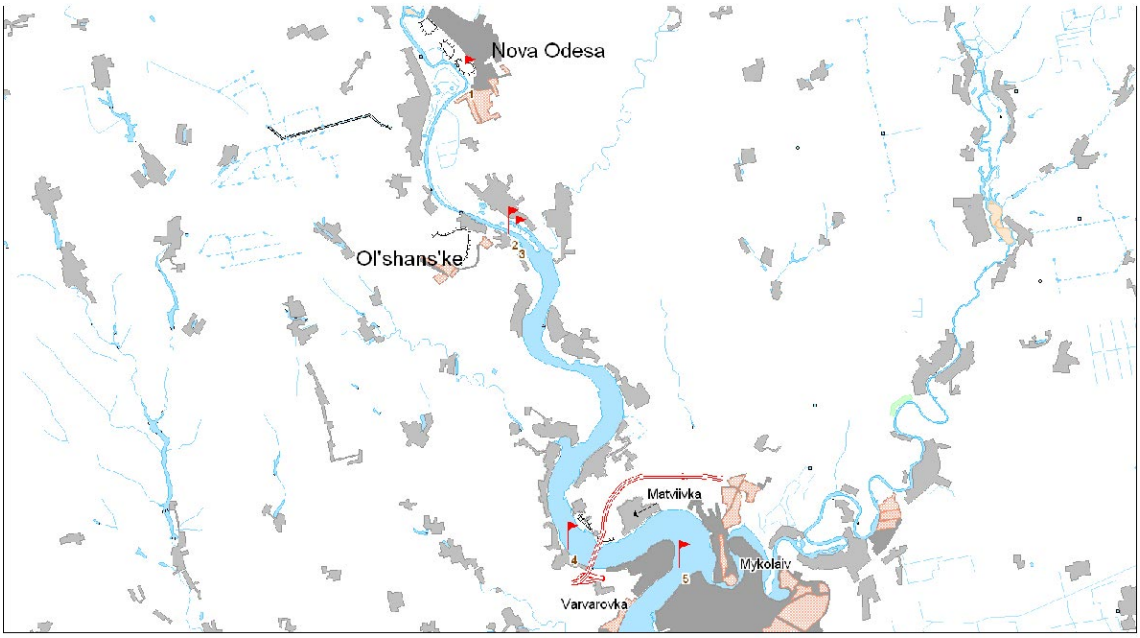
Table 6.1.9 The Average Annual Concentrations of Substances in the Cross-sections of Water Bodies in the Area of Construction in 2008 (in Ratio to the Corresponding MAC)

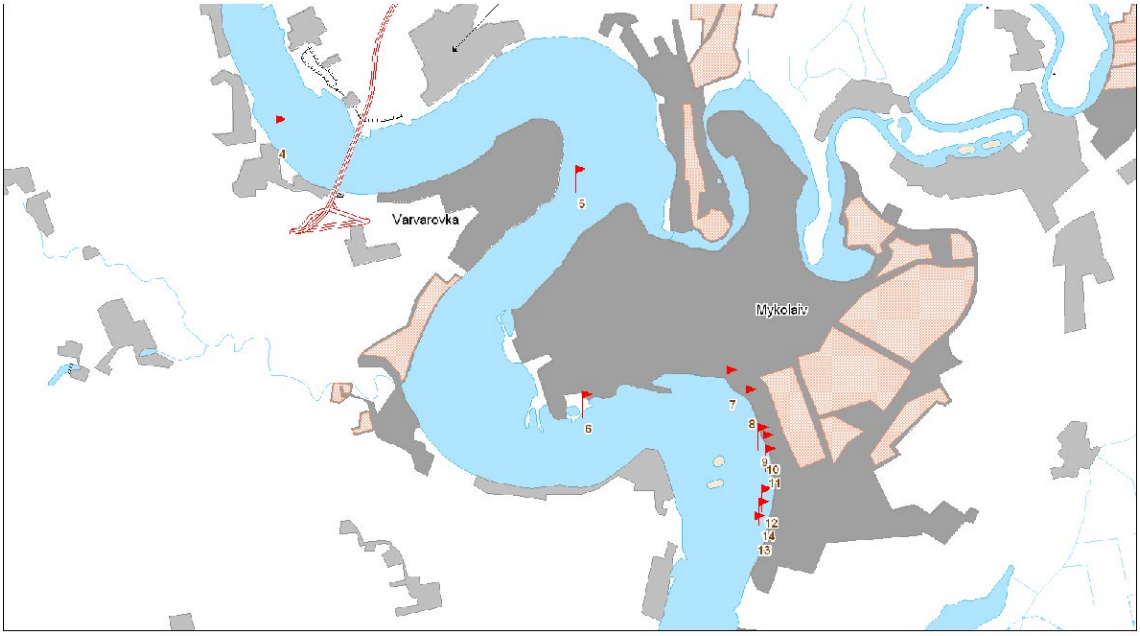
Sampling no, on the map	BOD_5,	COD,	Ammonium,	Nitrites,	Nitrates,	TDS,	Chlorides,	Sulfates,[3]	Petrochemicals,	Surfactants,	Total iron,	Total chromium,	Phosphates,
MAC (mg/dm^3)	**6.0**	**30**	**0.50**	**0.08**	**40**	**1000**	**300**	**100**	**0.05**	**0.5**	**0.3**	**0.005**	**0.17**
1. South Bug, Nova Odessa (within town borders, near landing stage, downstream of influx of Gnylyi Yelanets')	1.2	2.1	0.5	0.4	0.1	0.5	0.2	1.0	1.0	0.8	2.5	0.0	2.0
2. South Bug, Ol'shans'ke (within borders of the Sapetnya village, upstream of the Ol'shans'ke sewage treatment facilities)	1.0	1.6	0.2	0.3	0.1	0.5	0.2	1.1	0.2	0.5	1.5	0.0	1.5
3. South Bug, Ol'shans'ke (downstream of the Sapetnya village, downstream of theOl'shans'ke sewage treatment facilities)	1.6	2.0	0.5	0.3	0.1	0.6	0.2	1.1	0.3	0.9	1.8	0.0	2.1
4. South Bug, Slivino (downstream of the village, upstream of Mykolayiv, recreation center "Rodniki")	1.6	1.6	0.8	0.4	0.1	2.6	3.5	2.8	0.4	1.7	2.4	0.0	1.8
5. Bug lagoon, Mykolayiv (within city borders, Varavrivs'kyi bridge)	1.7	2.0	0.5	0.4	0.1	3.5	5.2	3.4	1.0	0.7	1.8	0.4	1.9
6. Bug lagoon, Mykolayiv (upstream of the affiliate of "BSSY", near the river port)	2.3	3.5	0.5	1.1	0.1	3.2	4.6	3.4	2.4	1.4	3.2	1.0	1.7
7. Bug lagoon, Mykolayiv (water intake of the heat electropower station of Mykolayiv)	1.2	1.7	1.1	1.3	0.1	5.1	7.9	5.1	0.5	0.5	2.5	0.0	1.4
8. Bug lagoon, Mykolayiv (upstream of the heat electropower station of Mykolayiv)	1.2	1.6	0.6	1.2	0.1	3.2	4.4	3.6	1.3	0.8	1.0	0.7	1.4
9. Bug lagoon, Mykolayiv (upstream of the discharge point of "Zorya-Mashproekt")	1.6	3.2	0.4	0.5	0.0	5.2	8.0	4.9	2.0	0.7	2.5	0.5	1.6

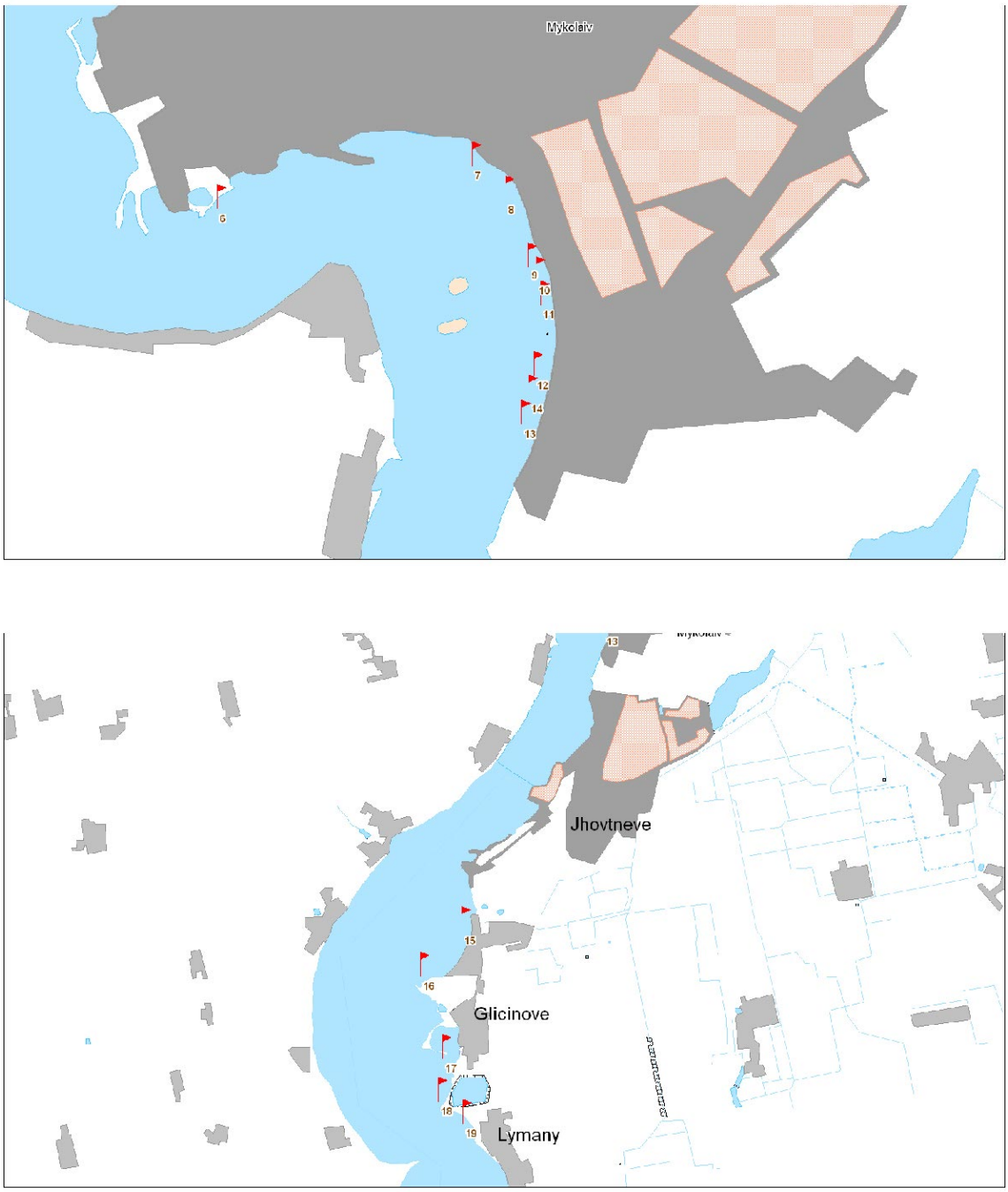
Sampling no, on the map	BOD_5,	COD,	Ammonium,	Nitrites,	Nitrates,	TDS,	Chlorides,	$Sulfates,^3$	Petrochemicals,	Surfactants,	Total iron,	Total chromium,	Phosphates,
10. Bug lagoon, Mykolayiv (downstream the discharge point of "Zorya-Mashproekt")	1.5	2.9	0.4	0.4	0.0	5.3	8.0	5.3	1.0	1.0	1.7	0.8	1.5
11. Bug lagoon, Mykolayiv (water intake of "Zorya-Mashproekt")	1.6	2.4	0.4	0.5	0.0	6.4	10.1	5.6	1.2	0.7	2.8	0.0	1.9
12. Bug lagoon, Mykolayiv (upstream the discharge point of "Warden Yards Ocean")	1.3	1.7	1.2	0.9	0.1	5.7	8.9	4.5	0.6	1.7	2.0	0.3	1.6
13. Bug lagoon, Mykolayiv (downstream of the "Warden Yards Ocean")	2.0	1.9	0.5	0.5	0.1	5.8	9.0	5.0	1.0	3.5	1.6	0.3	1.7
14. Bug lagoon, Mykolayiv (water area near BAT "Warden Yards Ocean")	1.4	2.5	0.7	0.6	0.1	5.8	9.0	5.2	1.0	1.5	1.4	0.3	1.7
15. Bug lagoon, Galytsynivka (upstream of the village, upstream of the of Mykolayiv sewage treatment facilities)	16.6	12.4	8.1	5.5	0.0	4.7	6.8	4.3	3.2	3.3	8.1	0.8	30.5
16. Bug lagoon, Galytsynivka (in the village, downstream of the Mykolayiv sewage treatment facilities)	13.2	12.1	7.5	3.2	0.0	5.0	7.7	4.5	1.3	2.7	11.6	0.8	9.4
17. Bug lagoon, Lymany (upstream of the“Alumina plant of Mykolayiv”, buoy № 101)	1.5	2.3	0.7	0.4	0.0	5.3	8.6	5.0	0.7	1.3	1.7	0.0	1.3
18. Bug lagoon, Lymany (downstream of the “Alumina plant of Mykolayiv», buoy № 81)	1.5	2.1	0.7	0.3	0.0	4.9	7.4	4.5	1.1	1.2	1.9	0.0	1.3
19. Bug lagoon, Lymany (water area near the “Alumina plant of Mykolayiv»)	1.6	2.1	0.8	0.4	0.0	4.9	7.7	4.3	1.1	1.2	2.2	0.0	1.4

NOTE: Hydro chemical monitoring was done by the subdivisions of Hydro meteorological service of Ukraine with a frequency of not less than twice per month; by Ecological inspection (Department of ecology and natural resource in Mykolaivs’ska oblast’) – once per month or once per 3 months; scientific researches was undertaken once during the field works

Source: the Ukrainian Hydrometeorological service: Department of ecology and natural resources in Mykolayivs’ka oblast’ and Institute of environmental geochemistry at the Southern Bug river and Bug lagoon in 2000-2010.


Nova Odesa
Ol'shans'ke
Matviivka
Mykolaiv
Varvarovka


Varvarovka
Mykolaiv



NOTE: Hydro chemical monitoring is conducted by the subdivisions of Hydro meteorological service of Ukraine with a frequency of not less than twice per month; by the Ecological inspection (Department of ecology and natural resources in Mykolaivs'ska oblast') – once per month or once per 3 months; scientific research was undertaken once during the field works.

Figure 6.1.5 Location of Water Quality Monitoring Points

(3) Air Pollution

There is no air pollution sampling data near the project area. The level of pollution of the atmosphere in the city is rather moderate for an industrial centre such as Nikolayev. Ambient air quality is now monitored by 4 posts located within the city limits as shown table 6.1.10.

Table 6.1.10 Average of Ambient Air Quality
(Average of Observed Data in Downtown of Mykolaiv)

Unit(mg/m^3)

No.	Name of location	Dust(max)	sulphur dioxide(max)	nitrogen dioxide(max)	carbon monoxide(max)
1	Observatornaya st., 1	0.0(0.3)	0.002(0.009)	0.03(0.12)	0(2)
2	CHigrina st. – Zhovtneviy Ave.	0.1(2.3)	0.003(0.011)	0.05(0.15)	1(5)
3	12th – Liniya – 7th Povzovzhnaya	0.0(0.3)	0.003(0.018)	0.04(0.13)	1(7)
4	regional Palace of Culture	0.0(0.2)	0.003(0.029)	0.04(0.12)	1(4)
	MAC(maximum allowable concentration)	0.15(-)	0.5(-)	0.04(0.085)	3(5)

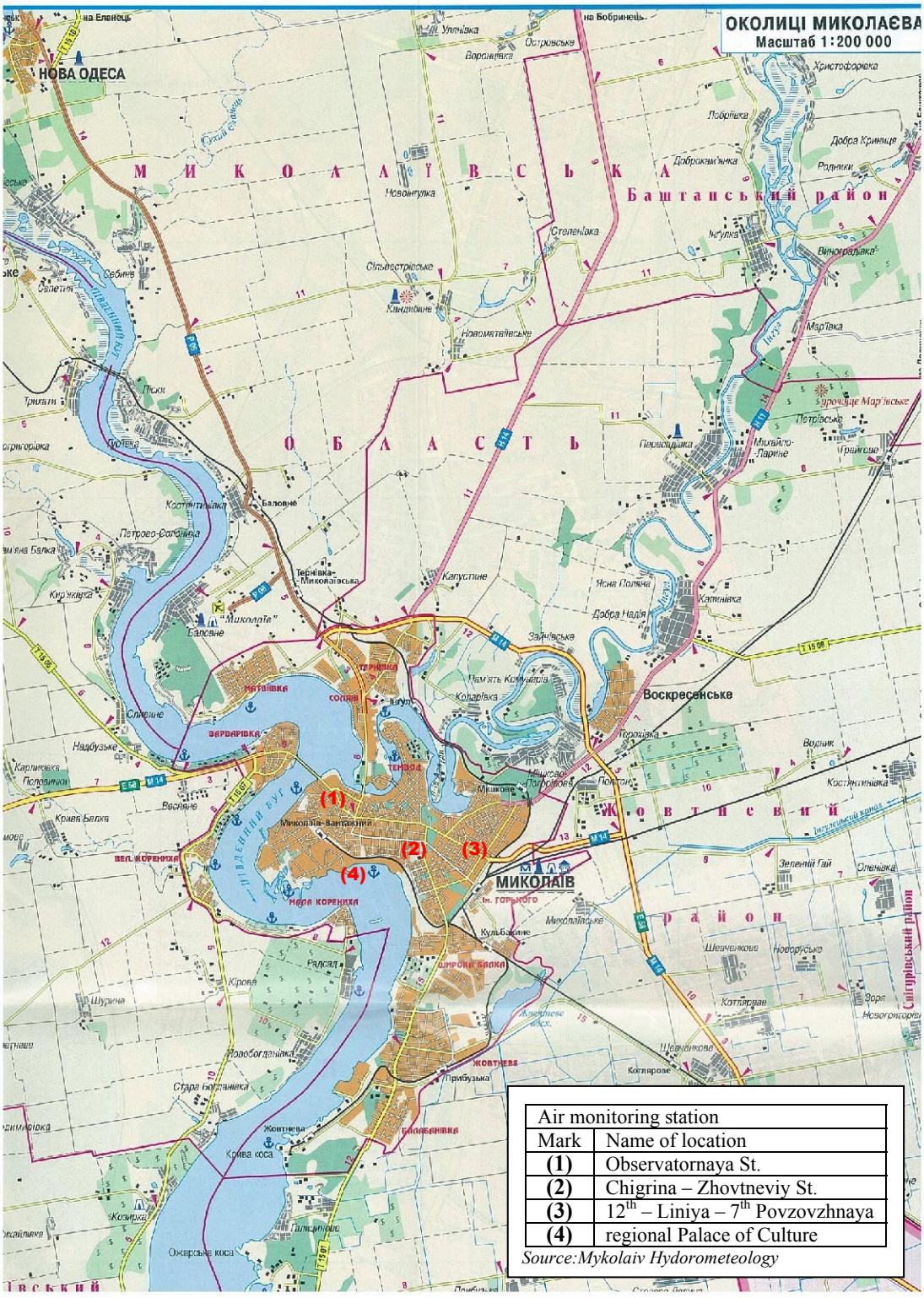
Source: Mykolaiv Regional Center for Hydrometeorology (observed in 2009, observation period four times a day)

Location of air monitoring station is shown in Figure 6.1.6.

Background concentration of pollutants based on data from Mykolaiv Regional Center for Hydrometeorology is shown below.

- Maximum concentration of nitrogen dioxide was under MAC (maximum allowable concentration).
- Maximum concentration of suspended particle matter was 1.5 of MAC.
- Maximum concentration of carbon monoxide was 1.4 of MAC.
- Concentration of sulphur dioxide, nitrogen oxide and carbon monoxide in the city did not exceed MAC at the monitoring posts.

On the whole, the atmosphere in the vicinity of the site where the bridge is going to be constructed is characterized by a low level of ambient air pollution.



Source: Mykolaiv Regional Center for Hydrometeorology (observed in 2009, observation period four times a day)

Figure 6.1.6 Location of Air Monitoring Stations

Around project site there is no emission source such as a trunk road and industry factory, therefore air quality in the project site is estimated in low level almost equal to the level in wildness. On the whole, the atmosphere in the vicinity of the site where the bridge is going to be constructed is characterized by a low level of ambient air pollution.

Baseline concentration in suburbs of the project site is estimated from the data similar to the conditions observed in Japan as reference values such as the air pollution concentration of NO_2 is mostly influenced by traffic vehicles emission. The observed data in Hokkaido in Japan are shown in the table 6.1.11. The concentrations of NO_2 in suburb in Hokkaido, which is defined as similar conditions on metrological and traffic stream network to the project site, are distributed within almost quarter of those in the city center; therefore, the concentrations of the project site enables to be estimated in accordance with the tendency as described in the Table 6.1.11.

Table 6.1.11 estimation of air pollution concentration in suburb of city (example of NO_2)

Location of sampling	*Observed data at Hokkaido in Japan	Observation and estimation in Mykolaiv region Ukraine
Maximum concentration in city downtown of Sapporo, Japan	0.020ppm（0.038mg/m^3）	0.05mg/m^3
Concentration in suburb of Chitose city, Japan	0.005ppm（0.010mg/m^3）	0.0125 mg/m^3 （estimated value from Japanese observation data）

*http://tenbou.nies.go.jp/gis/monitor/?map_mode=monitoring_map&field=2, (year average in 2009)

Thus, baseline of air pollution in the project site must be estimated far below the level of MAC in addition to not only NO_2 but also other pollutants such as Dust, SO_2 and CO

(4) Noise

There is no noise or vibration sampling data from near the project area. In Ukraine, constant monitoring of noise is not performed. Only a few special studies were performed at the main street intersections of Mykolaiv in 2010. Those studies showed 53 to 72 dB(A) at maximum level, which exceeds the standard level of 65 dB(A) in day time. Noise level in downtown is shown in table 6.1.12 and the location is shown in figure 6.1.7.

Mykolaiv along the trunk roads such as M14 (E58) is very high, especially during late night and early morning, because big Lorries are allowed to pass through.

Table 6.1.12 is the data in Mykolaiv region, which conducted measurements of equivalent noise levels near the roadway and residential areas of the city.

Table 6.1.12 Noise monitoring result in downtown Mykolaiv (2010)

No.	name of location	Day time	Night time
1	The intersection of Velyka Morska and Pyshkinska streets, on the sidelines	58～66 dB(A)	≤53 dB(A)
2	The intersection of Velyka Morska and Pyshkinska streets,in the residential area	51～53 dB(A)	≤46 dB(A)
3	The intersection of Velyka Morska and Artylerijska streets, on the sidelines	55～72 dB(A)	≤58 dB(A)
4	The intersection of Velyka Morska Artylerijska streets, in the residential area	53～55 dB(A)	≤46 dB(A)
MAC: Maximum allowable level for a building facing to road traffic. (SN 3077-84, annex № 16 DSP 173-96: for 1 floor of construction in traffic noise)		65 dB(A)	55 dB(A)

Source: Sanitary Epidemiological Service (SES) in Mykolaiv Oblast

These results show that on the sidewalks the main city streets of Mykolaiv may exceed permitted limits of equivalent noise level in daytime and nighttime. These excesses are not permanent and are not critical to the health of the residents. In residential areas, measured noise levels meet sanitary standards. Some discomfort can be felt by the residents of apartments with windows facing the roadway.

Source: Sanitary Epidemiological Service (SES) in Mykolaiv Oblast

Figure 6.1.7 Noise sampling location in Mykolaiv city

In the project site, currently there are no significant sources of noise pollution such as heavy traffic stream and factory.

The examples of the noise level observed in diversified scenery are shown in the table 6.1.13 Therefore, the baseline of noise level in the project site is estimated as under the level of 40 dB(A) in accordance with the condition in diversified scenery in the table 6.1.13.

Table 6.1.13 example of noise level by situation

Noise Level dB(A)	Condition in diversified scenery
120	Near airplane in case of take off
110	In front of 2 meter at car horn, riveting
100	Under viaduct when the train pass through
90	In front of 5meter at dog barking, inside the noisy factory, karaoke studio
80	Inside subway or train. In front of 1 meter at piano.
70	Noisy office or noise level in the street
60	Inside car, usual conversation
50	Quiet office, air conditioner when it works
40	Mid night in a street, in a library, quiet residential area in the day time
30	Mid night in a suburb, whistling voice
20	Rustle of leaves, second hand sound of clock

* http://www.geocities.jp/fkmtf928/dB_sound.html

For vibration in the project area the condition is same as noise pollution.

(5) Soil Contamination

There is no sampling data for soil contamination in the project area. Soil contamination monitoring has been conducted in Mykolaiv city as shown in table 6.1.14 and the location is shown in table 6.1.10.

Based on SN 4433-87 sanitary standards of allowable concentrations of chemicals in the soil, the Sanitary Epidemiological Service (SES) in Mykolaiv Oblast performed random checks of soil samples in the zones around the major industrial enterprises. Heavy metals in the soil were analysed to determine if they exceeded MAC. Currently, no sample were found exceeding MAC.

Table 6.1.14 Monitoring Result of Soil Contamination Survey in Mykolaiv City

No.	name of location	Cd	Lead	Hg
1	Prybuzka street, enterprise "Zoria - Mashproekt"	< 1 MAC	< 1 MAC	< 1 MAC
2	Zavodska str, Black Sea Shipyard	< 1 MAC	< 1 MAC	< 1 MAC
3	Korabeliv str, plant "Damenshiposhen", previously it was called "Warden Yards Ocean"	< 1 MAC	< 1 MAC	< 1 MAC
4	Sydnobudivnykiv square, plant "Dormashyna"	< 1 MAC	< 1 MAC	< 1 MAC
5	Chyhryna str, autostation	< 1 MAC	< 1 MAC	< 1 MAC
6	Krylova str, "Mykolaiv car assembly plant"	< 1 MAC	< 1 MAC	< 1 MAC
	Maximum allowable level	< 5mg/L	< 32mg/L	< 2.1mg/L

Source: Sanitary Epidemiological Service (SES) in Mykolaiv Oblast

All the mentioned points are shown on the map given below.

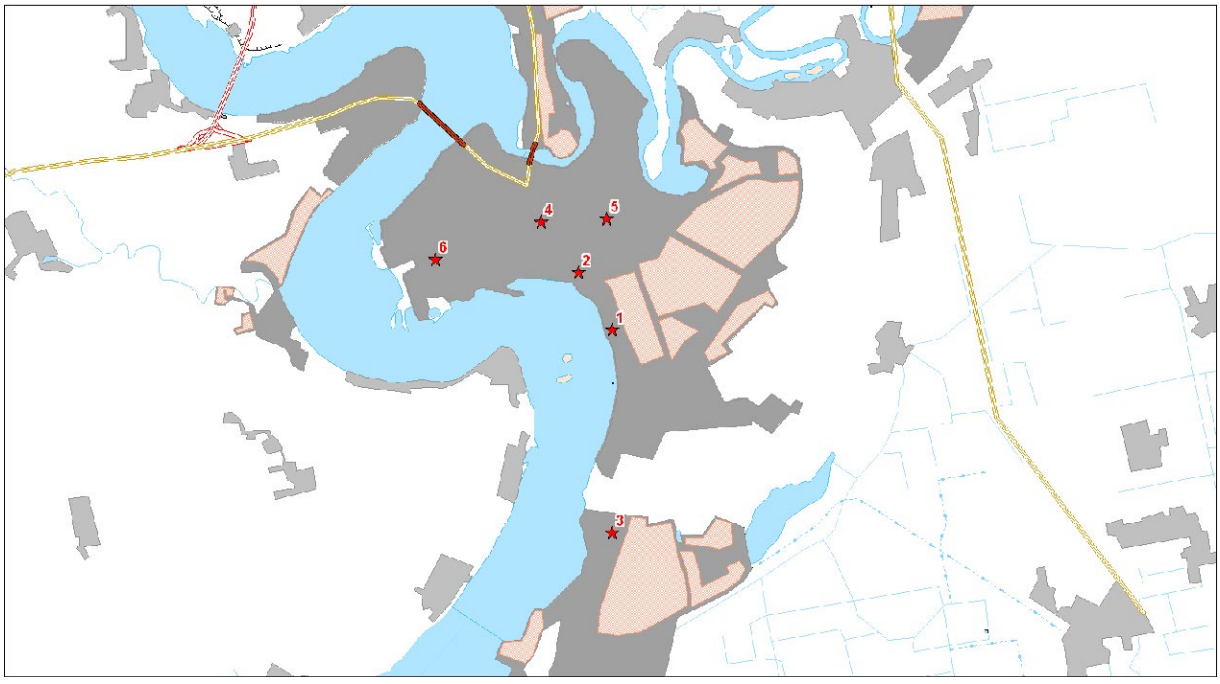


Figure 6.1.8 Sampling Locations for Soil Contamination

There are no pollutant sources in the project site such as mineral refining industry. Therefore, soil contamination level such as Cd, Lead and Hg in the project site is estimated as under the level of MAC in consideration of the surveyed results in the city where some factories would exist.

6.1.3 Environmental Legal Frame Work

(1) Environmental Protection Law

The section of the Environmental Protection Law relevant to epidemiological expertise is shown in Table 6.1.15.

Table 6.1.15 Environmental Protection Law in Ukraine (Ecological Examination)

Article 27. Facilities of Ecological Examination

The following shall be subject to ecological examination by experts

a) projects for patterns of developing and siting production forces, development of economic sectors, master plans of inhabited localities, patterns for regional planning and other documents preceding planning and design;

b) feasibility studies and calculations, projects of construction and reconstruction (expansion, technical modernization) of enterprises and other facilities which might negatively affect the environment, regardless of their forms of ownership or jurisdiction, including facilities for military purposes;

c) drafts of acts and documents concerning instructions, procedures and technical standards regulating economic activity negatively affecting the environment;

d) documents concerning the development of new machines, materials and substances, including the ones purchased abroad;

e) materials, substances, products, economic decisions, systems and facilities, the introduction or sale of which might entail violation of standards of ecological safety and negatively affect the environment or endanger the health of people. Subject to ecological examination may also be ecologically unsafe facilities and complexes in operation, including of a military and defence purpose.

Article 28. State Ecological Examination by Experts

State ecological examination shall be conducted by units of experts or specially established commissions of the Ministry for Environmental Protection and Nuclear Safety of Ukraine and its local bodies on the basis of the principles of legality, scientific substantiation, comprehensiveness, independence, transparency and long-term forecasting.

(Section 1 of Article 28 amended in conformity with Law No.81/96-VR of March 6, 1996)

The objectives of state ecological examination shall be

a) determination of ecological safety of economic and other activities which at the present time or in future can directly or indirectly produce a negative effect on the environment;

b) establishment of conformity with the requirements of legislation on environmental protection for pre-project, pre-planning, design work and other decisions;

c) assessment of the completeness and soundness of projected measures on environmental protection and the health of the population which are carried out by the Ministry for Environmental Protection and Nuclear Safety of Ukraine jointly with the Ministry of Public Health of Ukraine. (Item "c" of Article 28 amended in conformity with Law No.81/96-VR of March 6, 1996)

The state ecological examination can involve respective bodies of state administration of Ukraine, representatives of scientific research, project, design, and other institutions and organizations, higher educational establishments, the public, and experts of international organizations.

(Section 3 of Article 28 amended in conformity with Law No.81/96-VR of March 6, 1996)

Article 29. Mandatory Execution of Conclusions of a State Ecological Examination by Experts

The conclusions of a state ecological examination by experts after their approval by the Ministry for Environmental Protection and Nuclear Safety of Ukraine shall be mandatory for execution.

(Section 1 of Article 29 amended in conformity with Law No.81/96-VR of March 6, 1996)

A positive conclusion of a state ecological examination shall be the grounds to launch financing of all programs and projects. The implementation of programs, projects and decisions without a positive conclusion of a state ecological examination shall be prohibited.

Article 30. Public Ecological Examination

Public ecological examination shall be conducted by independent groups of specialists on the initiative of non-governmental associations as well as local bodies of power at the expense of their own resources or on a voluntary basis. Public ecological examination shall be conducted independently from state ecological examination. The conclusions of a public ecological examinations can be taken into consideration by bodies conducting state ecological examination as well as by bodies which are interested in implementing project decisions or in operating a corresponding facility.

6.1.4 Alternative of Project

Alternative of this Project are studied in Chapter 5 “5.2 Selection of the Highest Priority Route”.

6.1.5 Scoping and TOR

6.1.5.1 Project Impact

Impact of the Project during construction and during operation is described in Table 6.1.16 based on the information regarding the site condition.

Table 6.1.16 Scoping of Project Impact

	Affected item	Evaluation		Impact of project
		Construction	Operation	
1	Involuntary Resettlement	B	B	Resettlement of residents is not required. But some part of the land is in permanent use by individuals, therefore voluntary or involuntary acquiring of this land is required. In addition, it is necessary to acquire lands that are in constant use of legal persons such as business entities in state and private ownership.
2	Local Economy	C	C	During construction, there is little impact for the fishery industry because of prohibition of works during the spawning period. But in harvest season some fishing area will be limited by construction work. Some cultivated lands are lost due to purchase of land but other economic activities in the area will be activated.
3	Land use	C	C	Changing of land use is limited to within the road area.
4	Split of Communities	C	C	The route is planned so as not to pass through areas where houses are located. The places for rest will be established on the right bank, where there is no permanent resident population. There will no worsening for local traffic such as pedestrians between Matviivka Mykolaiv region and village Balovne if an overpass is provided by the project.
5	Local infrastructure Traffic/public facilities	C	C	The project road will be designed to cross the local railway and two local roads with a via duct or under pass.
6	Poverty, indigenous people	C	C	No effect from the project is foreseen.
7	Misdistribution of benefit and damage	C	C	There is no adverse impact by the construction of the road.
8	Cultural heritage	C	C	There is no record of cultural heritage sites along the route as of now.
9	Local conflict of interests	C	C	There is no adverse impact due to the construction of the road.
10	Water usage or water rights and Rights of Common	C	C	There is no change of water usage, water rights or rights of common.
11	Sanitation	C	C	During construction, waste and waste from the construction sites may cause local temporary deterioration of sanitary conditions of the water basin, but the area is limited to within the construction site. Proper treatment of construction waste is necessary. During operation impacts on health are within the national allowable (allowable) levels.
12	Infectious diseases such as HIV/AIDS	C	C	During construction civil work will be done by local companies, so there is no inflow of construction workers and there will be little impact.
13	Accident disaster	C	C	Planned construction does not include impacts that could cause major disasters. An emergency (accident) of natural origin can potentially be provoked by excavation work on the right bank slope that is exposed to landslides. Risk assessment is currently impossible because of lack of detailed design decisions of the general designer.

	Affected item	Evaluation		Impact of project
		Construction	Operation	
14	Traffic congestion	C	C	During Construction there may be detours or interruption of traffic. But the working period and area is limited.
15	Topography and Geology	C	C	During construction there will be no adverse impact because an existing borrow pit and quarry will be available. Change of geographical surface and deep geological layers are absent. The possible risk of landslides is on the right bank of the Southern Bug River. However, elimination or stabilization of active landslides will be considered as a positive impact because the construction will improve the current situation.
16	Soil Erosion	B	C	During Construction, proper construction methodology will be undertaken, but some soil erosion of the surface layer will occur on the right bank slopes, where it will be necessary to plant such things as surface grass, shrubs and trees as soon as possible.
17	Ground water	C	C	On the right bank there could be a possible increase in discharge of groundwater (artesian water leakage) due to formation of new sources (well springs), or the flow rate of existing increased.
18	Hydrological situation	C	C	Construction of the bridge does not effect the hydrological situation such as change of flow or erosion because average water flow rate around the bridge construction area is almost zero.(usual water flow rate is less than one cm/s, Observed maximum velocity of the river is 0.83 m/s :accordance probability=1%) Flow mainly depends on wind direction and tide. Minor changes due to the compression of the bed of the estuary (basin) are possible but, the effect will not be noticeable.
19	Coastal Zone	C	C	There is no impact foreseen.
20	Fauna, Flora and Biodiversity	C	C	During construction, excavation work will create some turbidity in the water such as sapropel, but it will settle out with insignificant effect. According to an interview with an ecological expert, the impact of the turbidity will be limited within the spawning period. Construction work will be prohibited within the spawning period. There are no rare animals or plants found within the planned project area. Impact on existing aquatic and terrestrial ecosystems will be minimal. Some forest area is going to be cut, but it will be compensated for in other areas. The loss of agricultural production, if any, will be minor and will be compensated for.
21	Climate change	C	C	No impact is foreseen.
22	Landscape	C	C	During construction there will be a temporary decline. The bridge crossing will be harmonized with the surrounding landscape and will be seen as one of the symbols of the city.
23	Global warming	C	C	There is no impact to the amount of carbonic anhydride emission.
24	Air pollution	C	B	During construction, air pollution emissions and dust from working machinery will be slight and temporary because the distance between the work area and residential area is over 100 meter. During operation, in residential areas beyond the project site, air pollution is not expected to exceed current health standards, because there is no other nearby significant sources of emissions. Due to redistribution of traffic from the city streets to the bypass route, the city should expect a significant reduction in air pollution in places of permanent residence of the people.
25	Water pollution	B	B	During construction, contamination of bottom sediments (sediment disturbance) churned by the bored piles and anchors in the construction of towers, could cause minor contamination and when working vessels, discharge from the construction area on the right bank. In operation, there will be some increase in flow rate due to the discharge of rain and melt water from the surface of the pavement and bridge site approaches. Because of the reduced flow to the treatment plants the negative impact will be neutralized.

	Affected item	Evaluation		Impact of project
		Construction	Operation	
26	Soil contamination	B	B	During construction, there could be contamination by spills of fuel and lubricants, or formation of construction debris. This can be avoided by adherence to construction rules. In operation there could be little contamination due to settling of vehicle emissions such as lead compounds because the quality of fuel in Ukraine has been improved.
27	Waste	C	C	During construction construction-waste will be recycled properly.
28	Noise and Vibration	C	B	During construction, impact of noise and vibration will be slight since the planned route does not run through an area with dense residential houses. The distance between the work area and the residential area is over 100 meter. The impact of noise during operation on the border zones of residential areas will exceed allowable levels of national standards in night, if traffic intensity reaches the forecast. In case of there is residential area where noise level exceed the standard, some counter measures such as planting tree and noise barriers are necessary.
29	Ground subsidence	C	C	Proper construction methodology will prevent subsidence.
30	Offensive odor	C	C	This is not foreseen to be an effect.
31	Bottom sediment	B	C	During construction, excavation work in the bottom sediment which include sapropel particles will create turbidity in the water and may cause some harm to various species.

A: significant negative impact is foreseen
B: some impact is foreseen
C: little or no impact is foreseen

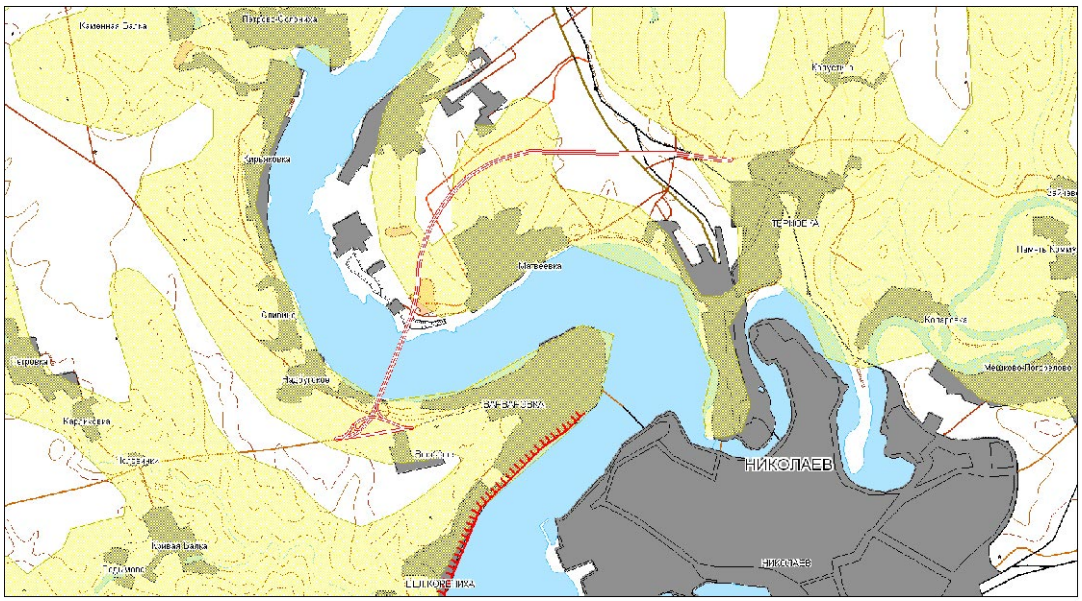
6.1.6 Forecast of Impact

6.1.6.1 Traffic Condition

Total daily traffic volume (Total/Day) and percentage of vehicle for the forecast of environmental impact are referred to "4.2.5 Future Traffic Volumes for New Mykolaiv Bridge" in case of free, which is supposed to be worse than other case.

6.1.6.2 Soil Erosion

Considerable parts of the highway route pass through the territory where is subject to erosion processes as shown in Figure 6.1.9.



Source: Ukrpromindustriya

Figure 6.1.9 Spreading of Erosion

Areal water (washing out of soil particles), wind (aeolian) erosion does not directly affect the stability of the road structures. However, incorrect planning for road construction could result in erosion that may activate processes that diminish the quality of the land resources. Linear erosion (a gully) develops on fragile slopes, sometimes due to thaw (water source), which could affect slopes that support the road sub grade.

Potentially risky areas

On the right bank the road alignment is planned along a gully.

Figure 6.1.10 Gully along the alignment of the planned road on the right bank

To prevent erosion it is necessary to arrange organized discharge of the runoff through rapid drainage, speed drops, and/or the filling of the gully. Water discharge from these structures should be directed to wells or a stone mattress to suppress the discharge of energy. An efficient means of fixing the bottom and sides of trenches after construction can be planting with grasses, shrubs and woody vegetation.

The locations at the intersection of roads Ul'ianovka – Simferopol, the railway and branches will require strengthening existing embankment after construction.

Figure 6.1.11 The Embankment on the Interchange "Clover Leaf"

Preventive measures

In case of road construction work with fine texture soils, it is necessary to apply measures on artificial protection against water erosion.

The basic rule is the strengthening of drainage ditches, fast flow arrangement of the step changes, and wells. The sub grade slopes should be planted with grass. Steep slopes should be provided with a grid to protect against water erosion.

To prevent soil erosion during construction works of the embankment, development or extraction reserve after removal of sod and vegetation cover should provide a temporary wastewater. It may consist of highland ditches, fencing of shafts on the slopes, and drainage ditches discharge in decreased areas, selective vertical planning in places with difficult runoff.

The following earth work for protecting erosion will be conducted.

- Planting trees by the support of flaming work.
- Planting trees will be installed in early stage of construction.
- Installing ditch for rain flow on slope.

6.1.6.3 Air Pollution

(1) Calculation of the emission of contaminants

The quantities are calculated for each different type of vehicle in the mixed traffic stream. The intensity of exhaust gas emissions is determined separately for each gaseous substance by the formula:

$$q = 2{,}06 \times 10^{-4} \times m \times \left[\left(\sum_{1}^{i} G_{ik} \times N_{ik} \times K_{k} \right) + \left(\sum_{1}^{i} G_{iд} \times N_{iд} \times K_{д} \right) \right],$$

Where

q : quantity of this type of pollution emission from traffic on a specific road section, g/m sec;

$2{,}06 \times 10^{-4}$: Transfer factor to the accepted units of measurement ;

m : Coefficient that takes into account road and motor conditions ;

G_{ik} : Average operating costs for the fuel type (brand) of carburettor cars, l/km;

$G_{iд}$: The same but for diesel cars, l/km;

N_{ik} : estimated prospective traffic for each vehicle type carburettor, autos/hour;

$N_{iд}$: The same for diesel cars autos/hour;

K_k and K_d: ratios adopted for this component of pollution for gasoline and diesel engine type.

Table 6.1.17 Average fuel consumption performance objectives per 1 km of road

Type of vehicle	Average operating costs of fuel, l/km
Cars	0.11
Small carburettor truck (≤ 5 tons)	0.16
Trucks carburettor (≥ 6)	0.33
Diesel Trucks	0.34
Buses carburettor	0.37
Diesel Buses	0.28

Source: Ukrpromindudtriia

Table 6.1.18 Coefficients Kk and Kd

Type of emissions	Type of engine	
	gasoline	diesel
Carbon monoxide	0,14	0,6
Nitrogen dioxide	0,015	0,06
Sulphur Dioxide	0,02	0,002
Soot	0,016	0,00058
Benzenes	$0{,}31 \cdot 10^{-6}$	$0{,}23 \cdot 10^{-6}$

Source: Ukrpromindudtriia

In calculating gross emissions the following parameters were adopted.

Legislated fuel density is: petroleum - 0.74 kg/l; diesel - 0.83 kg/l. When 1 kg of fuel oil is burnt it cause approximately 13 m3 of combustion products or flue gases. During the calculation the emissions of standard vehicles in areas that the projected road is to be built were taken to be: 10 litres of gasoline and 7 litres of diesel fuel consumption per 100 km at an average speed of 80 km/hour.

The ratio of cars adopted the average one, with diesel engines - 40%, respectively with gasoline - 60%.

Results of calculations of gross emissions of contaminants due to traffic stream are given in table 6.1.19.

Table 6.1.19 Emissions from vehicles on the project road

in year	Daily traffic volume (Total/Day)	Length of project road (km)	Gross emissions from traffic stream per day, kg
2015	13,800	13.19	834.8
2035	28,500		2013.3

Thus, if the intensity of traffic growth is in line with the projected estimates, gross emissions of CONTAMINANTS in 20 years will increase more than in 2.4 times.

The forecast calculation does not include possible changes in fuel quality, engine specifications, or the use of alternative energy sources in vehicles.

(2) Calculation of concentration by traffic streams

Calculations of the concentrations due to polluted substances at different distances from the road were conducted by the Gaussian distribution model in the atmosphere at small altitudes.

The concentrations of air pollutants such as carbon monoxide, hydrocarbons, nitrogen oxides, lead compounds, etc. along the road are determined by the formula:

$$C = \frac{2q}{\sqrt{2\pi} \times \sigma \times V \times \sin\varphi},$$

Where

- C : concentration of this type of pollution in the air, g/m^3;
- σ : Standard deviation of the Gaussian dispersion in the vertical direction, m;
- V : Wind speed, which prevails in the current month, m/sec;
- φ : Angle that includes wind direction to the route of the road. At angles of 90 to 30 degrees wind speed should be multiplied by the sine of the angle, at angles less than 30 degrees: the coefficient 0.5.

(3) Results of emissions dispersion calculations

Calculations were conducted for the boundaries of zones of influence: backup- technological strip at soft shoulder (BTS), a protective strip for the environment (PS) and at existing building as shown in Table 6.1.20. BTS is the edge of the Right of Way, which includes a maintenance zone. PS is the zone subject to environmental impact, and in this area new construction of houses, or sanitary protected facilities are prohibited by regulation.

Table 6.1.20 Expected concentrations of contaminants from vehicle engine emissions (without background)

(unit: mg/m^3)

Contaminants index	Mac (Maximum allowable concentration)	BTS (30 m, on line of the ROW)		PS[3] (300 m from the Road edge)	
		Year 2015	Year 2035	Year 2015	Year 2035
CO	3 mg/m^3	0.165065806	0.398099886	0.019107	0.046080
*NO_2	0.04 mg/m^3	*0.005502	*0.01327	*0.000637	*0.001536
*NO	0.06 mg/m^3	*0.005502	*0.01327	*0.000637	*0.001536
SO_2	0.5 mg/m^3	0.000550219	0.001327	0.0000637	0.000153601
Soot	0.150 mg/m^3	0.0010179130	0.0024549680	0.0001178240	0.0002841640
**Benz	0.003μg/ m^3	0.000068776	0.000165872	0.000007961	0.000019200

* Forecasted concentration ratio of NO_2/NO_x and NO/NO_x are supposed 0.5.
** Japanese criteria for Benzenes are applied because of no standard in the Ukraine.

The table 6.1.20 shows that concentrations of all other contaminants in the air are expected to be within allowable limits.

Outside of the protective zone exceeding of MAC of contaminants in air due to vehicles exhaust is not expected in any case.

As the approach road alignment with the bridge was chosen so as not to approach a housing district, it is not expected that air pollution from vehicle emissions will exceed maximum allowable concentration in the vicinity of the existing buildings.

(4) Mitigation Measures

During construction, following proper measurements will reduce the impact.

- Periodical watering on road near resident and washing of tire of vehicles in construction site.
- Strict observation of speed limit of construction vehicles.
- Using cover for dust on transportation of materials.

During operation, following proper road design and technological solutions will reduce dust formation.

- in accordance with DBN V. 2.3-4:2007 conventional design; coating designs using advanced materials, and using mitigation measures such as,
- installation of an improved pavement, which reduce dust formation;
- strengthening of the roadside with asphalt curb, adjacent area with grass; Water Pollution

6.1.6.4 Surface Waters Pollution by Bottom Sediments

Surface water of the flat water area in the Southern Bug River could suffer the impacts both during construction and operation of the bridge construction Project. During construction it is expected that water contamination by the disturbance of the sediments in the setting of the bridge supports. During operation receiving contaminants from the surface of the pavement may occur.

[3] Calculations were made without regard to availability of natural (relief, vegetation) and artificial (building code) obstacles in the way of distributing the emissions.

(1) During Construction

Bottom sediments of the Bug lagoon (flat water) were formed over many millennia. But only in the last century has the bio-geo-system been influenced by the growing of technological loading. Significant changes in chemical composition that occurred during this time in the bottom-delaying the roof are observed only in the upper 10 centimetres layer. (Speed of sedimentation is about 1 mm/per year.). Taking into account the tendency for migration of contaminants in a wet solid phase, the increase in density and decrease in the coefficient of porosity with depth, and the pore water in capsulated organic layers, one can conclude that the thickness of the artificial layer of sediments does not exceed 0,4-0,5 m, weight of the skeleton which is 0.4-0.6 g × cm^{-3}, average - 0,5. Therefore further calculations were performed for the 0.5-meter layer of bottom sediments[4], taking into account the weighted average and maximum values of the content of pollutants identified in previous studies. (EIA 2004)

Alternatives for Main Bridge Type in shown Figure 6.1.14 and Table 6.1.22 shows the amount of sediment volume subject to water contaminations based on the Bridge pier base type and based on the volume of the disturbed technological layer of bottom sediments

[4] **sapropel** (geology), unconsolidated sedimentary deposit rich in bituminous substances.

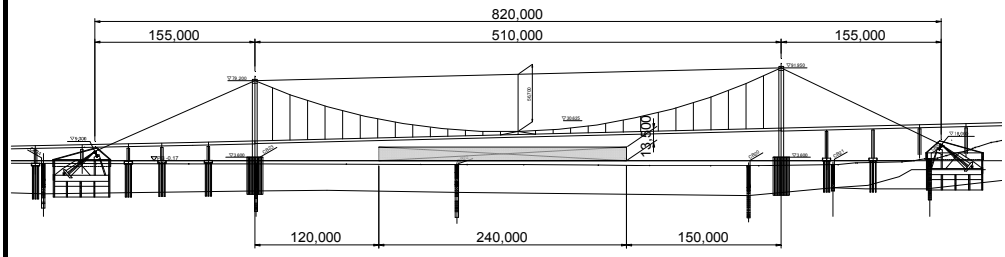
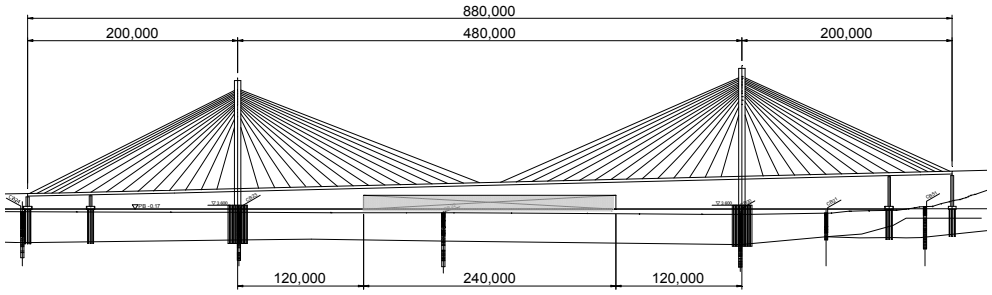
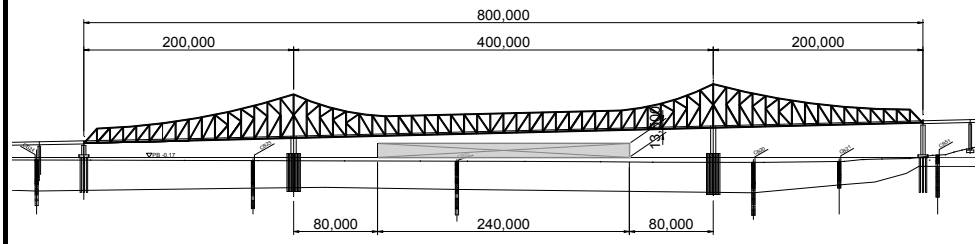
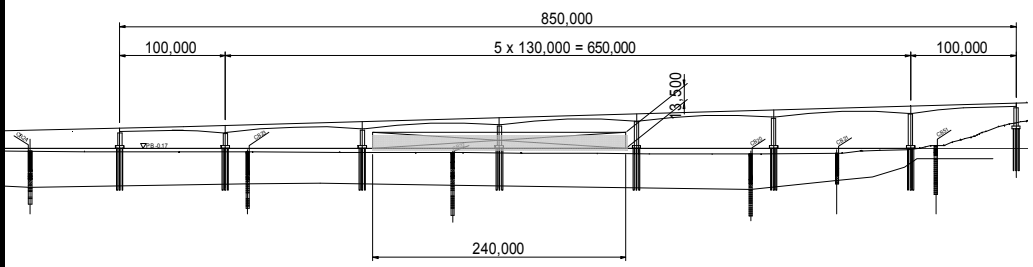
	Side View
Plan A: Suspention Bridge	Navigation channel: 240m x 1 Safety margin: 120m + 150m 
Plan B: Cable Stayed Bridge	Navigation channel: 240m x 1 Safety margin: 120m x 2 
Plan C: Steel Truss Bridge	Navigation channel: 240m x 1 Safety margin: 80m x 2 
	Side View
Reference : Steel-box girder Bridge	Navigation channel: 120m x 2 Safety margin: little 

Figure 6.1.12 Alternatives for Main Bridge Type

Table 6.1.21 Disturbed Sediment by Bridge Type

Variant №.	Type of bridge	Combination of span (total nearly 2,000m)	Type of pier base	disturbed sediment (ton)
1	Steel Box Girder type	20@60～120	Bored pile	775
2	Suspension + Girder	@1400 + 12@50	Pier is settled outside of sapropel	198
3-1	Suspension or cable stayed + Girder	12@50 + @510 ＋26@45	Reinforced solid cast	277
3-2*	ditto	ditto	Cylinder caisson	10
3-3*	ditto	ditto	Steel drilling pile	9

*JICA F/S report 2011 recommends these types of Bridges and piers

Thus, in terms of anthropogenic puddle pollutants of the technological layer of sediments the preferred variants should be № 3-2 № 3-3.

Given the significant amount of dilution of contaminated sediments during construction, especially in the deep parts of the lagoon (flat water), Variant №1 is characterized as the most environmentally damaging and that it could have a significant influence on the ecosystem of Southern Bug river pollution by heavy metals, petrochemicals and organ chlorine compounds.

Distribution of solid particles due to the construction of Variant № 1 is estimated at 1 km above and below the project construction.

Variants № 2, №3-1, №2-3 and №3-3: Distribution of solid particles from the shallow flat water has an expected length of 500-750 m above and below the projected construction. During construction, contaminant basement work will do not exceed MAC, including organic colloidal forms of heavy metals. The spread of contamination during the construction variant for the № 1 will take place two times faster than on variants №2, №3-1, №3-2, and №3-3.

Variants № 1 is the most dangerous from the perspective of environmental impact and may lead to local excess of MAC of heavy metals in flat waters during construction. Variants №2, №3-1～№3-3 are characterized by the close parameters of environmental impact and would not cause the significant environmental damages.

Thus, from the perspective of the environmental impact on bottom sediments contamination, the most viable variants for construction are № 3-2 and №3-3.

- Mitigation measures

  Construction methods for options № 3-2 and №3-3 will be the Sheet pile well concrete method with silt fence as shown in Figure 6.1.15. By adapting this construction method contamination from turbulence during basement work will be limited.

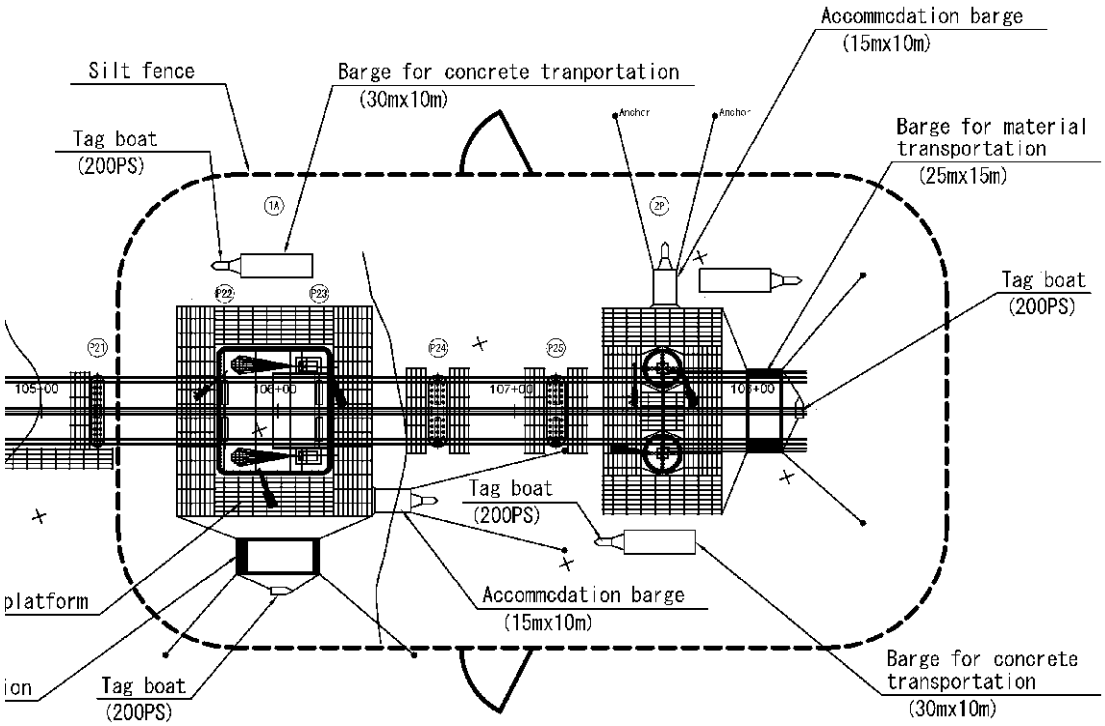


Figure 6.1.13 Bridge Construction Works with Silt Fence

Other prevention measures for water pollution shall be applied as follows,

- Installation of water treatment basin for effluent water from construction area.
- Strict custody of oil, fuel and hazardous material, keep distance from water way.

1) During Operation

During the operation, run off water from the road pavement may impact on the aquatic environment. These discharges can be contaminated because of flushing from pavement of the following:

- products of destruction of road surfaces;
- Condensed emissions, abrasion of tires;
- dirt from the car surfaces;
- substances used to fight the winter slipperiness (anti-icing material);
- loss of granular and liquid substances that are transported;
- Substances that fall on the roadway because of emergencies (accidents, spills, loss of cargo, etc.).

Discharges from pavement could affect the chemical properties of the water environment.

Factors that influence the content and concentration of pollutants that are washed from the roads are the intensity of the rain, duration of previous period without rains intensity of traffic, garbage collection and other factors. Contamination of wastewater reaches the largest concentrations in the first 10-30 minutes from the start of rain (which roughly coincides with the peak intensity of the rain).The following data on chemical composition of road washings is obtained from literature data.

Table 6.1.22 The Average Concentration of Contaminants in the Surface runoff of Auto Roads [5]

Indexes	Substance concentrations(mg/dm^2)				
	Switzerland	Germany	France	USA	Ukraine
Suspensions and emulsions	150	140-310	205	53-450	105
COD	120	107-230	83	34-240	24.8-42.0
BOC_5	9	5-11	92	4-45	6.1-7.8
Aromatic hydrocarbons	0.0045	to 0.04	-	-	-
Lead	0.45	0.04	-	0.04-2.9	0.219
Ammonia	1.2	0.01-2.2	1,45	-	1.8-7.4
Phosphorus	0.35	0.25-1.9	-	0.05-1.7	1.04-1.94

Source: Ukrpromindudtriia

The concentrations of impurities in the surface runoff at the inlet to the treatment plant, in the process of clearing and on leaving the treatment plant are shown in the following table.

Table 6.1.23 The Concentrations of Impurities in the Surface runoff Received at the Treatment Plant after Settling and after Cleaning

Control points	Suspended substances, mg/l	Petrochemicals, mg/l
Entrance to the treatment plant	1000	50
Accumulating capacity	100	7 (settler section)
Exit from the treatment plant	under 10	0.3

Source: Ukrpromindudtriia

On the main bridge section, run off water from the pavement will flow through a drain pipe and be introduced to the settling reservoir on the left bank and after it is treated flow into the Southern Bug River as shown in Table 6.1.24. During the earth work, drainage water will be collected in a side ditch along a steep slope and be introduced into the seepage pit installed at the lowest location. Thus, the surface draining of the bridge wouldn't have a negative influence on the Southern Bug river quality.

6.1.6.5 Soil Contamination

(1) Impacts during Construction

Indirect impacts to the soils while the project is under construction are the contamination with dust, vehicle fumes, fuel lubricants and waste.

Direct measures to protect the soils are:

- Protection from the occurrence of erosion processes in areas adjacent to the road, construction of open flow culverts, ensuring the smooth flow of trays with a full flow of water transmission.
- Prevention of erosion in the input and output headroom riverbed tubes by strengthening concrete slabs with the flow moderator of grassroots party.

Following soil reservation measures in the road construction will be conducted

- In the case of excavation work, the top soil layer should be removed to a thickness of 0.15 to 0.30 m. The estimated amount of fertile soil, which is to be utilized, is 120 to 240 thousand m^3. Later on that top soil should be used to create a fertile layer of on the subgrade slopes and ditches with the surplus allocated to improve the fertility of nearby farmlands.

[5] Ievgeniiev I.Ie., Karimov B.B. Autoroads and environment. — M.: OOO "Trasdornauka", 1997. - 285 pages.

- The soil at the sites that are temporarily allocated for construction purpose (access ways, marshalling yards, temporary construction sites, etc.) should be restored to their original condition after completion of works and returned to the land users.

(2) Impacts during Operation

During operation of the highways direct impact on the soil as a result of pollution caused by lead compounds, which enters the environment from the burning of motor vehicle fuel.

Average exhaust emissions of gasoline engines contain 0.23 ～ 0.50 kg of lead per 1 ton of fuel. In burning fuel more than 40% of the lead is injected into the atmosphere, while the rest remains as dust. The maximum content of lead compounds in the exhaust gas is 60 mg/m^3. Thus 20% is in the form of an aerosol that is released and is 80% solid. First it gets into the air environment and later it accumulates on the surface soil and vegetation cover in the form of inorganic compounds.

In previous years the use of high-leaded gasoline has resulted in significant contamination of lead in the wayside areas, especially along main roads. Measurements recorded concentrations of lead in soil that exceeds the MAC (32 mg / kg) by dozens of times, and sometimes - a hundred times.

In 2001, the Law of Ukraine № 2786-III "On banning importation and sale in Ukraine of leaded gasoline and lead additives in gasoline", was passed. From January 1st, 2003 it has been prohibited to import lead gasoline into Ukraine or to sell lead additives in gasoline or leaded gasoline.

Thus, today the excess of MAC of lead in the soils at the existing building are not expected. It is clear that with increasing environmental performance of fuels, soil pollution will decrease also.

6.1.6.6 Noise

(1) Calculation of noise during operation

In road construction the noise level is calculated for average speed of traffic flows Vav., that is 0.7Vcalc., where Vcalc. – calculated project speed. According to the professor P.I.Pospielov's formula, at the distance of 7.5 m from the centre of the nearest lane traffic noise can be determined from the equation:

$L = 50 + 8.8\lg N$, Where, N means calculated traffic intensity

At the given level of sound L_0 at the distance l_0 from the ionising source, the noise L_1 at the distance l excluding attenuation in the air (α=0.005 dBA) is calculated by the formula:

$$L_1 = L_0 - 20 \lg l/l_0, \text{ dBA}$$

Roads with heavy traffic form a so-called Cylindrical sound wave for which noise reduction depends on the distance between the source and the point being analysed and is determined by the formula:

$$L_1 = L_0 - 10 \lg l/l_0, \text{ dBA}$$

When calculating the equivalent noise $L_{eqv.}$ in a roadside strip to consider necessary adjustments due to the traffic conditions by the formula:

$$L_{eqv.} = L + DL_v + DL_i + DL_d + DL_k + DL_{диз.} + DL_L x K_p, \text{ dBA}$$

Where,

DLv - adjustment based on speed, dBA;

DLi - adjustment due to the longitudinal gradient, dBA;

DLd - adjustment due to the type of coverage, dBA;

DLk - adjustment based on the composition of motion, dBA;

DLdiesel. - adjustment due to the number of diesel cars, dBA;

DLL - value of noise reduction depending on the distance l from extreme lane, m ;

Kp - coefficient that takes into account the type of surface between the road and the point being analyzed.

(2) Calculations for Noise Loading

The calculated noise level at the Road Edge (at the distance on ROW) is shown on Table 6.1.25, which noise level exceeds the National Noise standard for transportation noise such as 65 dB(A) for day time and 55 dB(A) for night time(Sanitary Norm 3077-84, annex № 16 DSP 173-96).

Table 6.1.24 The Calculated Noise Levels at the Border Zone of Influence

BTS (end of road area from centre of near lane 30 m)		PS (environmentally affected area from road 300 m)	
2015	2035	2015	2035
62.6	**66.0**	52.6	**56.0**
MAL 65dB(A) in daytime, 55dB(A) in night time			

Noise levels at some of existing building are shown in Table 6.1.25. From this result noise level in some locations are predicted to exceed the national standard.

Table 6.1.25 The Calculated Noise Levels at the Existing Buildings[6]

Location of existing structure	Distance from the road (m)	Forecasted noise Level dB(A)		* MAC
	Forecasted year	2015	2035	
1- Ternivka	582	49.7	53.1	daytime65dB(A) night time55dB(A)
2- Int. airport. "Mykolayiv"	190	54.6	58.0	
3- Balovne	712	48.9	52.2	
3- Matviivka	1235	46.5	49.8	
4- cementary	350	51.9	55.3	
4- Matviivka	916	47.8	51.1	
4 - Balovne	1269	46.3	49.7	
5- Matviivka	745	48.7	52.0	
6- Balovne	1107	46.9	50.3	
6- silicate plant	100	57.4	60.7	
7– Nadbuz”ke	115	56.8	60.1	
7– "Rodniki" recriational base	107	57.1	60.4	
8- Vesniane	931	47.7	51.1	

*Sanitary Norm 3077-84, annex № 16 DSP 173-96

The locations of existing buildings are shown in Figure 6.1.14.

[6] calculations are made without regard to availability of natural (relief, vegetation) and artificial (building) code obstacles in the way of noise distributing .

Figure 6.1.14 Conventional sources of emissions and noise (the calculated points)

The significant sources of noise except motor vehicles are not identified because silicate plants have not worked. The baseline noise level around the project site is estimated around 40 dB(A), shown in the table 6.1.13; the combined noise level is obtained by using following the formula.

L (A+B) = 10Log10 (10** (LA/10) + 10** (LB/10))

Examples of combined noise levels are shown in the table 6.1.26.

Table 6.1.26 example of combined noise level

Combined noise level	Example of traffic noise	Example of baseline noise
$L_{(A+B)}$ dB(A)	L_A dB(A)	L_B dB(A)
60.0	60	40
55.1	55	40
46.2	45	40
43.0	40	40

Calculation results in the table 5.15 show that the noise level at existing buildings, where currently nobody accommodates, will exceed 55dB(A) of the noise standard (MAL) in night time; therefore, any measures may not be requisite. In case that some residents existed at the location in the future, some mitigation measures to reduce the noise level would be required when it has exceeded MAL.

(3) measures to reduce noise and emissions

Noise level due to the construction work is a little impact because the project alignment is selected as to keep distance from residence.

During construction following counter measures are required at least.

- Prohibition of work in night time.
- Noise source such as concrete mixer shall be located over 300 meters from resident area.
- Installation of temporary noise barrier near residence, if necessary.
- Observance of speed limit.
- To keep strictly maintenance of construction vehicle.
- Installation of low noise and vibration construction machine.

In case traffic stream increase as forecasted noise level due to traffic may exceed the standard for noise. If noise reduction becomes necessary in the future traditional protective measures can be recommended:

- - installation of tree and shrubs;
- - application of noise control barriers, screens.

The impact of the application of noise control measures at the calculation point is determined by the formula:

L = Leqv. – DLg. – DLs.,

where

Leqv. – equivalent level of noise;

DLg. – reduction of noise levels by the different types of green planting ;

DLs. – reduction of noise by using screen.

The designed sound-proof screens should also take into account the requirements of aesthetics and safety.

The noise protection screens should be placed closer to the roadway without gaps, taking into account traffic safety and road maintenance. The length depends on the length of the building. On both sides the height of the screen should gradually decrease to eliminate aerodynamic effects.

Usage of screens made of sound-absorbing materials will reduce 2-3 dBA more than reverberating sound walls and are not leading of noise increasing on roads. Mineral fibrous materials (mineral wool, fibre glass) are used for sound absorbing. Mitigation Measures

6.1.7 Result of impact forecast and necessary mitigation measures.

Summary of forecast for environmental item to be selected in Table 6.1.16 of the project impact are show in Table 6.1.28, and necessary measures to keep environmental is shown in Table 6.1.29.

Table 6.1.27 forecast summary

No	Item	Forecast summary
1	Involuntary resettlement	There are 54 private enterprises and 11 public land owners in the project areas. Based on the Land acquisition Law, Notification documents are necessary one year before implementation of the project.
2	Soil erosion	During road construction incorrect planning may result in erosion on the right bank where linear erosion could develop on the fragile slopes. To prevent soil erosion during construction on the embankment, after removal of sod and vegetation cover temporary storm water facilities should be provided. These may consist of ditches at the tops of the slopes, fencing on the slopes, drainage ditches that discharge in appropriate areas, and selective vertical planning in places with difficult runoff.
3	Air pollution	Air pollution from the traffic stream may impact residents nearby. Based on the forecast air pollution levels, the concentrations caused by the traffic do not exceed the standards at the existing buildings (including residential) or within the environmental protection zone (100 m from the road).
4	Water pollution (bottom sediment)	Excavation work for the footings may affect water quality of the South Bug River. The design of the bridge and the construction methods selected in the F/S will reduce contamination caused by disturbing the bottom sediment. The footings will be constructed by the sheet pile well concrete method. During operation, run off water from the road may contaminate the water of the South Bug River. Drain pipes on bridge and side ditch are to be installed, and effluent water is to be treated or infiltrated.
5	Soil contamination	Emissions from vehicle fuel, especially Lead, may contaminate the soil along the road. Calculations indicate that the contamination level will not exceed the allowable standards.
6	Noise	Transportation noise may affect residents along the road. Noise level at existing buildings will exceed the standard in night time.

Table 6.1.28 summary of counter measures

No	Item	Mitigation measures
1	Involuntary resettlement	RAP in compliance with the Ukrainian Law and also JICA Guidelines will be considered.
2	Soil erosion	Following earth work for the protecting of erosion during construction will reduce erosion during operation. - Planting trees by the support of flaming work. - Planting Tree on slope in early stage of construction. - Installing ditch for rain flow on slope. - Vegetation in an early stage of construction is preferable.
3	Air pollution	During construction following proper measurement will reduce the impact. - Periodical watering on road near resident and washing of tire of vehicles in construction site. - Strict observation of speed limit of construction vehicles. - Using cover for dust on transportation of materials.
		During operation following proper road design and technological solutions will reduce dust formation. - in accordance with DBN V. 2.3-4:2007 conventional design; coating designs using advanced materials, and using mitigation measures such as, - installation of an improved pavement, which reduce dust formation; - strengthening of the roadside with asphalt curb, adjacent area with grass;
4	Water pollution (bottom sediment)	During construction, excavation works *silt fences are to be installed to prevent diffusion of contamination of bottom sediment. Other prevention measures for water pollution shall be applied as follows. - Installation of water treatment basin for effluent water from construction area. - Strict custody of oil, fuel and hazardous material, keep distance from water way.
		During the operation run off water from the road pavement may impact the aquatic environment. These discharges can be contaminated because of flushing from pavement of the following: - products of destruction of road surfaces; - Condensed emissions, abrasion of tires; - dirt from the car surfaces; - substances used to fight the winter slipperiness (anti-icing material); - loss of granular and liquid substances that are transported; Substances that fall on the roadway because of emergencies (accidents, spills, loss of cargo, etc.).
5	Soil contamination	To prevent the contamination impacts of dust, vehicle fumes, fuel, lubricants and waste on the soils during construction following measures shall be taken. - Protection from the occurrence of erosion processes in adjacent areas to the road, construction of open flow culverts, ensuring the smooth flow of trays with a full flow of water transmission. Following soil reservation measures in the road construction will be conducted: - In the case of excavation work, the top soil layer should be removed to a thickness of 0.15 to 0.30m. The estimated amount of fertile soil, which is to be utilized, is 120 to 240 thousand m^3. Later on that topsoil should be used to create a fertile layer on the subgrade slopes, and ditches with the surplus allocated to improve the fertility of nearby farmland; - The soil at the sites that are temporarily allocated for construction purposes (access ways, marshalling yards, temporary construction sites, etc.) should be restored to their original condition after completion of works and returned to the land users.
6	Noise	During construction following counter measures are required. - Prohibition of work in night time. - Noise source such as concrete mixer shall be located over 300 meters from resident area. - Installation of temporary noise barrier near residence, if necessary. - Observance of speed limit. - To keep strictly maintenance of construction vehicle. - Installation of low noise and vibration construction machine.
		During operation, in case there is resident in the area where noise level exceeds standard, some measures such as planting trees along road and/or noise barrier are necessary.

Cost for counter measures shown in table 6.1.28 is included in construction cost.

Estimated cost for the extra environmental measurement is shown in Table 6.1.29.

Table 6.1.29 Estimated cost for the environmental measurement

Environmental Measurement	Scale of measurement	Estimated cost for works	Estimated Labour cost for the works	Toatal estimated cost (UAH)
Silt Fence during excavation work	1014 meter	Confidential	100 %	Confidential
Reforest ration (not including land)	3,000 baby trees/ha Total 12.8 ha of forest area.		100 %	

Source: JICA survey Team

6.1.8 Monitoring Plan

(1) Introduction

The environmental impact assessment of the Project will be prepared before project development.

The impact assessment will be carried out based on technical basis. Therefore, the monitoring programs in both construction and operation periods are essential in order to determine the actual consequences of the project and to the study effectiveness and efficiency of the mitigation measures. If the mitigation measures are not effective, modification or improvement will be required. Results of the monitoring programs will be used to prevent or avoid impacts from the project properly and quickly. In addition, the monitoring results will be used to modify or improve the mitigation measures which are considered ineffective or inefficient.

The environmental monitoring programs in the construction period will be included as part of the construction contract to be conducted by the third party under supervision of the project owner. In the operation period, the project owner will provide budget for the third party to conduct the monitoring work. After each phase of the monitoring work in both construction and operation periods, monitoring results will be reported to project owner.

The environmental monitoring programs consist of the followings.

(1) Air quality monitoring program
(2) Noise level monitoring program
(3) Water quality monitoring program
(4) Land acquisition and Resettlement monitoring program

Environmental monitoring plan

(2) Sampling Locations

The sampling locations of natural environment are shown in Appendix 8.

(3) Monitoring Form

The monitoring form shows the sampling details such as sampling items, comparable thresholds, and frequency and duration of monitoring in the Appendix 8.

Monitoring results shall be reported through a competent receiving office.

It is highly appreciated that reporting interval quarterly during construction and two times a year after two years during operation period.

(4) Monitoring Cost

The monitoring cost estimation is shown in the Appendix 8.

6.2 Land Acquisition

6.2.1 Justification as to the Land Acquisition

Technical-economical justification as to the construction of highway stream crossing over Southern Bug River in city Mykolaiv include analyses of 4 alternative variants of the highway river crossing. Analysis of alternatives takes into account social and environmental conditions and economic factors. According to Table 5.2.2, “Route 2” was selected as the most suitable for the proposed road and bridge crossing because it had the shortest lengths of the bridge and approach road and it hardly had any relocation of houses. The result was agreed in the prescribed manner highway bridge. On the basis of pre-decision the route of the bridge was made a promising route bridge in "The general plan Mykolaiv city", which was approved in 2007. The local authority reserved strip land to be acquisition for the construction. Currently land, which fell in the border zone in use natural and legal persons, is reserved for construction. To implement the planned construction these lands should be acquired from the current owners and provide the proponent of the construction.

6.2.2 Legal Frame Work for Resettlement and Land Acquisition

6.2.2.1 Frame Work in Ukraine

(1) Legal Framework

Relevant Ukrainian law with respect to the Resettlement Policy Framework is as follows:

- Constitution of Ukraine of 28th June, 1996 No. 254k/96-BP (Articles 13, 14, 41);
- Civil Code of Ukraine of 16th January, 2003, No. 435-IV (Article 350);
- Land Code of Ukraine of 25th October, 2001 No. 2768-1II (Articles 9, 12, 13, 16, 92, 123, 284, 144-151,156, 157);
- Law of Ukraine "On Valuation of Property, Property Rights and Professional Assessment Activities in Ukraine" on 12th July, 2001, No. 2658-III;
- Law of Ukraine "On Lease of Land" of 6th October, 1998, No. 161 -XIV;
- Law of Ukraine "On Local Government in Ukraine" on 21st May, 1997, No.280/97-BP
- Law of Ukraine "On Land Assessment (Valuation) of 11th December, 2003, No. 1378-IV;
- Regulation of the Cabinet of Ministers of Ukraine of 17th. November 1997 No. 1279 "On Size of and Procedure for Calculation of Agricultural and Forestry Losses Subject to Compensation";
- Resolution of the Cabinet of Ministers of Ukraine of 19th March, 2008 No. 224 "On Approval of the Regulation of the State Committee of Land Resources of Ukraine";
- Resolution of the Cabinet of Ministers of Ukraine of 4th March, 2004 No. 266 "On Approval of the Standard Contract on Development of the Land Utilization Project Involving Grant of Plot";

- Resolution of the Cabinet of Ministers of Ukraine of 19th April, 1993 No. 284 "On Procedure for Calculation and Compensation of Losses to Land Owners and Land Users";
- Resolution of the Cabinet of Ministers of Ukraine of 11th October, 2002 No. 1531 "On Expert Valuation of Land Parcels";
- Resolution of the Cabinet of Ministers of Ukraine of 10th December, 2003 No.1891 "On Approval of Property Valuation Method";
- Resolution of the Cabinet of Ministers of Ukraine of 10th September, 2003 No. 1440 "On Approval of National Standard No.1"General Methods of Property and Property Rights Valuation";
- Resolution of the Cabinet of Ministers of Ukraine of 28th October, 2004 No. 1442 "On Approval of National Standard No.2 "Real Estate Valuation";
- Order of the State Committee of Land Resources of Ukraine of 12th November, 1998 No. 118 "On Approval of Methodical Recommendations for Expert Money Evaluation of Land Parcels";
- Order of the State Committee of Land Resources of Ukraine of 9th January, 2003 No.2 "On Approval of Procedure for Expert Money Evaluation of Land Parcels".

The above laws and resolutions regulate the purchase (allotment), lease and use of private and state owned land needed for public use. These laws and regulatory/legal acts include articles for the use of land for development purposes and for investment projects.

These laws and regulations, while allowing the government to acquire private lands for economic development, protect the rights of property owners and ensure just compensation.

(2) Key Provision of the Legislation

In accordance with Article 13 of the Constitution of Ukraine, the land, its mineral wealth, atmosphere, water and other natural resources within the territory of Ukraine, the natural resources of its continental shelf, and the exclusive (maritime) economic zone, are objects of the right of property of the Ukrainian people. Ownership rights on behalf of the Ukrainian people are exercised by bodies of state power and bodies of local government determined by the Constitution.

Under Article 146 of the Land Code of Ukraine (Purchase of Plots of Land for Public Needs):

1) The state authorities and local government bodies shall have the right to purchase (buyout) land plots owned by individuals and legal entities, for the public needs indicated in the Land Code in line with their authority specified by this Code, among them:
   a) For buildings and structures of state authorities and local government bodies;
   b) For buildings, structures and other industrial facilities of the state and communal property;
   c) For natural reserve facilities and other environmental protection purposes;
   e) For defence and national security purposes;
   f) for the construction and maintenance of line facilities and transport and energy infrastructure objects (roads, railways, gas and water lines, electric power transmission lines, airports, oil and gas terminals, power plants, etc.);
2) At least one year prior to the buy-out, the land plot owner shall be notified in writing by the body wanting to buyout the land.

3) The buy-out of a plot of land shall be subject to consent of the owner thereof. The value of the land plot shall be ascertained on the basis of its monetary and expert valuation according to the methodology approved by the Cabinet of Ministers of Ukraine.

4) If the land plot owner disagrees with the buy-out value, the issue shall be solved by the court.

6.2.2.2 JICA Policy for Resettlement

The key principle of JICA policies on involuntary resettlement is summarized as follows.

(1) Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives.

(2) When, population displacement is unavoidable, effective measures to minimize the impact and to compensate for losses should be taken.

(3) People who must be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported, so that they can improve or at least restore their standard of living, income opportunities and production levels to pre-project levels.

(4) Compensation must be based on the full replacement cost as much as possible.

Description of "replacement cost" is as follows.

Land	Agricultural Land	The pre-project or pre-displacement, whichever is higher, market value of land of equal productive potential or use located in the vicinity of the affected land, plus the cost of preparing the land to levels similar to those of the affected land, plus the cost of any registration and transfer taxes.
	Land in Urban Areas	The pre-displacement market value of land of equal size and use, with similar or improved public infrastructure facilities and services and located in the vicinity of the affected land, plus the cost of any registration and transfer taxes.
Structure	Houses and Other Structures	The market cost of the materials to build a replacement structure with an area and quality similar or better than those of the affected structure, or to repair a partially affected structure, plus the cost of transporting building materials to the construction site, plus the cost of any labor and contractors' fees, plus the cost of any registration and transfer taxes.

(5) Compensation and other kinds of assistance must be provided prior to displacement.

(6) For projects that entail large-scale involuntary resettlement, resettlement action plans must be prepared and made available to the public. It is desirable that the resettlement action plan include elements laid out in the World Bank Safeguard Policy, OP 4.12, Annex A.

(7) In preparing a resettlement action plan, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance. When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people.

(8) Appropriate participation of affected people must be promoted in planning, implementation, and monitoring of resettlement action plans.

(9) Appropriate and accessible grievance mechanisms must be established for the affected people and their communities.

Above principles are complemented by World Bank OP 4.12, since it is stated in JICA Guideline that "JICA confirms that projects do not deviate significantly from the World Bank's Safeguard Policies". Additional key principle based on World Bank OP 4.12 is as follows.

(10) Affected people are to be identified and recorded as early as possible in order to establish their eligibility through an initial baseline survey (including population census that serves as an eligibility cut-off date, asset inventory, and socioeconomic survey), preferably at the project identification stage, to prevent a subsequent influx of encroachers of others who wish to take advance of such benefits.

(11) Eligibility of Benefits include, the PAPs who have formal legal rights to land (including customary and traditional land rights recognized under law), the PAPs who don't have formal legal rights to land at the time of census but have a claim to such land or assets and the PAPs who have no recognizable legal right to the land they are occupying.

(12) Preference should be given to land-based resettlement strategies for displaced persons whose livelihoods are land-based.

(13) Provide support for the transition period (between displacement and livelihood restoration.

(14) Particular attention must be paid to the needs of the vulnerable groups among those displaced, especially those below the poverty line, landless, elderly, women and children, ethnic minorities etc.

(15) For projects that entail land acquisition or involuntary resettlement of fewer than 200 people, abbreviated resettlement plan is to be prepared.

In addition to the above core principles on the JICA policy, it also laid emphasis on a detailed resettlement policy inclusive of all the above points; project specific resettlement plan; institutional framework for implementation; monitoring and evaluation mechanism; time schedule for implementation; and, detailed Financial Plan etc.

6.2.2.3 Comparison between JICA and Ukraine

Difference of legal framework for resettlement between JICA Guidelines and Law of Ukraine is shown in Table 6.2.1

Table 6.2.1 Difference of legal framework for resettlement between JICA Guidelines and Law of Ukraine

	JICA Guidelines	Law of Ukraine	Gap between JICA GL and Ukraine	Policy of the Project
1.	Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives. (JICA GL)	It is mandatory stipulated in Ukraine, in particular: legislation on building rules (for example "State sanitary rules of planning and building of populated localities. State sanitary rules № 173-96), besides - DBN A.2.2-1-2003" Content and composition of materials of EIA Report during designing and construction of factories, buildings and facilities " (items 1.3, 2.5, 2.35, 2.41)	Basically there is no difference.	It is stipulated that the RAP comply with the term of the national legislation of Ukraine and included requirements of JICA GL. (former JBIC GL April 2002)

	JICA Guidelines	Law of Ukraine	Gap between JICA GL and Ukraine	Policy of the Project
2.	When population displacement is unavoidable, effective measures to minimize impact and to compensate for losses should be taken. (JICA GL)	Answer is the same as the above stated one	ditto	ditto
3.	People who must be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported, so that they can improve or at least restore their standard of living, income opportunities and production levels to pre-project levels. (JICA GL)	This is directly stipulated by item 2.39 of DBN A.2.2-1-2003, as well as legislation in the field of social security, besides by Law of Ukraine "On alienation of plots of land, other immovable property objects located on them, which are in private possession, for the public needs or because of motives of social necessity.	ditto	ditto
4.	Compensation must be based on the full replacement cost as much as possible. (JICA GL)	Financial approaches of alienation of plots of land are defined by Law of Ukraine "On alienation of plots of land, other immovable property objects located on them, which are in private possession, for the public needs or because of motives of social necessity", in accordance with which the buy back price includes cost of the plot of land, residential building, other buildings, facilities, perennial plantings located on it, with consideration of losses inflicted to the owner due to buying out of the plot of land, including losses which will be inflicted to the owner in connection with early termination of his obligations to the third parties, in particular loss of profit. Cost of the plot of land shall be defined under agreement on the grounds of his expert monetary evaluation, performed in accordance with the legislation. Reports on expert monetary estimation of plot of lands subject to the state expert expertise. Entities of such estimation shall be defined by body of executive power or by body of local administration (article 5).	Ditto	ditto
5.	Compensation and other kinds of assistance must be provided prior to displacement. (JICA GL)	Article 14. (of the same law). In a case of buying-out of the plot of land, other objects of immovable property. Then cost of such objects can be compensated in monetary form or other equivalent plot of land can be provided into the ownership.	Ditto	

	JICA Guidelines	Law of Ukraine	Gap between JICA GL and Ukraine	Policy of the Project
6.	For projects that entail large-scale involuntary resettlement, resettlement action plans must be prepared and made available to the public. (JICA GL)	Article 10. (of the same law) Executive body or local government administration within one month after proposal on land allocation is received, shall take decision on buying-out for the public needs of the plot of land, objects of immovable property located on it. Body which takes decision on buying-out of the plot of land and other objects of immovable property, which are located on it, shall in written form be obliged to inform of that the owner (owners) within five days from the moment when such decision is taken but not later than three months before the plots of land buying-out. Legislation does not specifically stipulate informing of those people (public at large) who has not got bearing to the resettlement. In Ukrainian legislation there is no such term as "Resettlement action plan". For the resettlement the land organization (land management) documents shall be worked out by specialized institutions like Land management Institute, but the documents publishing and extensive discussion shall be carried out at the discretion of the construction Customer, because there is no such requirement in the legislation.	Ditto	
7.	In preparing a resettlement action plan, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance. (JICA GL)	See answer to question 6. This Law stipulates individual consultations and agreements only. In particular, Article 11 "Owner of the plot of land within one month from a date when he receives an written notice shall inform in written form the body of executive power on giving consent to hold negotiations on terms and conditions of the buying-out or on such buying-out rejection". In case of giving consent, then the negotiations are held on the buy back price, periods and other buying-out terms and conditions and then conclude the buy and sell agreement (Article 12). In case the consent of an land owner is not obtained, then the said objects may be compulsorily expropriated because of motives of the public (social) necessity. Compulsory expropriation of the plots of land due to the public necessity shall be performed upon the court award (Article 15).	Ditto	Ditto
8.	When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people. (JICA GL)	Ukrainian legislation does not stipulate that.	Actually most people understand Russian and Ukrainian also.	Ditto

	JICA Guidelines	Law of Ukraine	Gap between JICA GL and Ukraine	Policy of the Project
9.	Appropriate participation of affected people must be promoted in planning, implementation, and monitoring of resettlement action plans. (JICA GL)	The affected persons are offered either another plot of land (if available) or compensation in money (article 4). Participation of the affected persons in planning and monitoring is not stipulated.	Basically there is no difference.	Ditto
10.	Appropriate and accessible grievance mechanisms must be established for the affected people and their communities. (JICA GL)	Owner may refuse to be resettled, and then the body applies to court where it shall prove necessity and impossibility to avoid resettlement. The court takes decision on amount of compensation (Article 16). Owner may order and himself to pay alternative expert evaluation (Article 5). The law does not stipulate that an owner of plot of land may be the first to apply to court, however Constitution of Ukraine allows citizens to apply to court on all the issues relating to their interests: Extract from the Constitution: Article 55. Each person is guaranteed the right of appeal to court on awards, actions or absence of actions of bodies of state power, local government administrations, public servants and officers. Each person has the right to apply on protection of his rights to the Authorized on human rights of Supreme Council of Ukraine. Each person having used all the national means of legal defence has the right to apply for defence of his rights and freedoms to relevant international judicial agencies or in relevant bodies of international organizations as a member or participant. Besides: Article 40. Every one has the right to send individual or collective written applications or in person apply to bodies of state power, local government administrations and public servants and officers of these bodies, who are obliged to consider the application and give grounded answer within the period stated by the law.	Basically there is no difference.	Ditto

	JICA Guidelines	Law of Ukraine	Gap between JICA GL and Ukraine	Policy of the Project
11.	Affected people are to be identified and recorded as early as possible in order to establish their eligibility through an initial baseline survey (including population census that serves as an eligibility cut-off date, asset inventory, and socioeconomic survey), preferably at the project identification stage, to prevent a subsequent influx of encroachers of others who wish to take advance of such benefits. (WB OP4.12 Para.6)	The affected persons are determined by land management documents at the stage of the project preparation (Appendix B, DBN A.2.2-3-2004). Concerning the infringers: Law of Ukraine "On alienation of plots of land, other immovable property objects located on them, which are in private possession, for the public needs or because of motives of social necessity". Article 13 "Owner of plot of land who has received the written notice on the plot of land buying-out for the public needs, in case of alienation of these objects in favour of another person, shall be obliged to warn such person of buying-out of the stated objects for the public needs and notify a body which has taken decision on the alienation. Decision on the buying-out of the plot of land for the public needs shall remain in force for a new owner of the plot of land".	Basically there is no difference.	Ditto
12.	Eligibility of benefits includes, the PAPs who have formal legal rights to land (including customary and traditional land rights recognized under law), the PAPs who don't have formal legal rights to land at the time of census but have a claim to such land or assets and the PAPs who have no recognizable legal right to the land they are occupying. (WB OP4.12 Para.15)	Only legally drawn up right of ownership, including right of ownership for land is valid In Ukraine.	There is no right for illegal PAPs.	Ditto
13.	Preference should be given to land-based resettlement strategies for displaced persons whose livelihoods are land-based. (WB OP4.12 Para.11)	Ukrainian legislation does not stipulate that.	There is difference.	Ditto
14.	Provide support for the transition period (between displacement and livelihood restoration). (WB OP4.12 Para.6)	Ukrainian legislation does not stipulate that.	There is difference.	Ditto
15.	Particular attention must be paid to the needs of the vulnerable groups among those displaced, especially those below the poverty line, landless, elderly, women and children, ethnic minorities etc. (WB OP4.12 Para.8)	Ukrainian legislation does not stipulate that.	There is difference.	Ditto
16.	For projects that entail land acquisition or involuntary resettlement of fewer than 200 people, abbreviated resettlement plan is to be prepared. (WB OP4.12 Para.25)	Ukrainian legislation does not stipulate that.	There is difference.	Ditto

6.2.2.4 JICA Policy for Land Acquisition

(1) The Government of Ukraine will use the Project Resettlement Policy the Project Policy for the Construction of Mykolaiv Bridge specifically because existing national laws and regulations have not been designed to address involuntary resettlement according to international practice, including JICA's policy. The Project Policy is aimed at filling-in any gaps in what local laws and regulations cannot provide in order to help ensure that PAPs are able to rehabilitate themselves to at least their pre-project condition. This section discusses the principles of the Project Policy and the entitlements of the PAPs based on the type and degree of their losses. Where there are gaps between the Ukraine legal framework for resettlement and JICA's Policy on Involuntary Resettlement, practicable mutually agreeable approaches will be designed consistent with Government practices and JICA's Policy.

(2) Land acquisition and involuntary resettlement will be avoided where feasible, or minimized, by identifying possible alternative project designs that have the least adverse impact on the communities in the project area.

(3) Where displacement of households is unavoidable, all PAPs (including communities) losing assets, livelihoods or resources will be fully compensated and assisted so that they can improve, or at least restore, their former economic and social conditions.

(4) Compensation and rehabilitation support will be provided to any PAPs, that is, any person or household or business which on account of project implementation would have his, her or their:

- Standard of living adversely affected;
- Right, title or interest in any house, interest in, or right to use, any land (including premises, agricultural and grazing land, commercial properties, tenancy, or right in annual or perennial crops and trees or any other fixed or moveable assets, acquired or possessed, temporarily or permanently;
- Income earning opportunities, business, occupation, work or place of residence or habitat adversely affected temporarily or permanently; or
- Social and cultural activities and relationships affected or any other losses that may be identified during the process of resettlement planning.

(5) All affected people will be eligible for compensation and rehabilitation assistance, irrespective of tenure status, social or economic standing and any such factors that may discriminate against achievement of the objectives outlined above. Lack of legal rights to the assets lost or adversely affected tenure status and social or economic status will not bar the PAPs from entitlements to such compensation and rehabilitation measures or resettlement objectives. All PAPs residing, working, doing business and/or cultivating land within the project impacted areas as of the date of the latest census and inventory of lost assets(IOL), are entitled to compensation for their lost assets (land and/or non-land assets), at replacement cost, if available and restoration of incomes and businesses, and will be provided with rehabilitation measures sufficient to assist them to improve or at least maintain their pre-project living standards, income-earning capacity and production levels.

(6) PAPs that lose only part of their physical assets will not be left with a portion that will be inadequate to sustain their current standard of living. The minimum size of remaining land and structures will be agreed during the resettlement planning process.

(7) People temporarily affected are to be considered PAPs and resettlement plans address the issue of temporary acquisition.

(8) Where a host community is affected by the development of a resettlement site in that community, the host community shall be involved in any resettlement planning and decision-making. All attempts shall be made to minimize the adverse impacts of resettlement upon host communities

(9) The resettlement plans will be designed in accordance with Land Code of Ukraine (from October 25, 2001 N2768) and JICA's Policy on Involuntary Resettlement.

(10) The Resettlement Plan will be translated into local languages and disclosed for the reference of PAPs as well as other interested groups.

(11) Payment for land and/or non-land assets will be based on the principle of replacement cost.

(12) Compensation for PAPs dependent on agricultural activities will be land-based wherever possible. Land-based strategies may include provision of replacement land, ensuring greater security of tenure, and upgrading livelihoods of people without legal land titles. If replacement land is not available, other strategies may be built around opportunities for re-training, skill development, wage employment, or self-employment, including access to credit. Solely cash compensation will be avoided as an option if possible, as this may not address losses that are not easily quantified, such as access to services and traditional rights, and may eventually lead to those populations being worse off than without the project.

(13) Replacement lands, if the preferred option of PAPs, should be within the immediate vicinity of the affected lands wherever possible and be of comparable productive capacity and potential.(Agricultural land for land of equal productive capacity means that the land provided as compensation should be able to produce the same or better yield the AP was producing on his/her land prior to the project. The production should be in the planting season immediately following the land acquisition. It can be for a future period if transitional allowance equal to the household's previous yield is provided to the AP household while waiting for the land to get back to the same productivity as the previous land.) As a second option, sites should be identified that minimize the social disruption of those affected; such lands should also have access to services and facilities similar to those available in the lands affected.

(14) Resettlement assistance will be provided not only for immediate loss, but also for a transition period needed to restore livelihood and standards of living of PAPs. Such support could take the form of short-term jobs, subsistence support, salary maintenance, or similar arrangements.

(15) The resettlement plan must consider the needs of those most vulnerable to the adverse impacts of resettlement (including the poor, those without legal title to land, ethnic minorities, women, children, elderly and disabled) and ensure they are considered in resettlement planning and mitigation measures identified. Assistance should be provided to help them improve their socio-economic status.

(16) PAPs will be involved in the process of developing and implementing resettlement plans.

(17) PAPs and their communities will be consulted about the project, the rights and options available to them, and proposed mitigation measures for adverse effects, and to the extent possible be involved in the decisions that are made concerning their resettlement.

(18) Adequate budgetary support will be fully committed and made available to cover the costs of land acquisition (including compensation and income restoration measures) within the agreed implementation period. The funds for all resettlement activities will come from the Government.

(19) Displacement does not occur before provision of compensation and of other assistance required for relocation. Sufficient civic infrastructure must be provided in resettlement site prior to relocation. Acquisition of assets, payment of compensation, and the resettlement and start of the livelihood rehabilitation activities of PAPs, will be completed prior to any construction activities, except when a court of law orders so in expropriation cases. (Livelihood restoration measures must also be in place but not

necessarily completed prior to construction activities, as these may be ongoing activities.

(20) Organization and administrative arrangements for the effective preparation and implementation of the resettlement plan will be identified and in place prior to the commencement of the process; this will include the provision of adequate human resources for supervision, consultation, and monitoring of land acquisition and rehabilitation activities.

(21) Appropriate reporting (including auditing and redress functions), monitoring and evaluation mechanisms, will be identified and set in place as part of the resettlement management system. An external monitoring group will be hired by the project and will evaluate the resettlement process and final outcome. Such groups may include qualified NGOs, research institutions or universities

Cut-off-date of Eligibility

In Ukraine there is no general idea and no definition of "Cut-off date". The cut-off-date of eligibility refers to the date prior to which the occupation or use of the project area makes residents/users of the same eligible to be categorized as PAPs and be eligible to Project entitlements. In the Project, Cut-off dates for titleholders will be the date of notification under the Land Acquisition Act; one year before the start of Project, not yet decided as of F/S stage. This date has been disclosed to each affected village by the relevant local governments and the villages have disclosed to their populations.

Principle of Replacement Cost

All compensation for land and non-land assets owned by households/shop owners who meet the cut-off-date will be based on the principle of replacement cost. Replacement cost is the amount calculated before displacement which is needed to replace an affected asset without depreciation and without deduction for taxes and/or costs of transaction as follows:

The buy-out of a plot of land shall be subject to consent of the owner thereof. The value of the land plot shall be ascertained on the basis of its monetary and expert valuation according to the methodology approved by the Cabinet of Ministers of Ukraine.

If the land plot owner disagrees with the buy-out value, the issue shall be solved by the court.

6.2.3 Scope of Land Acquisition

6.2.3.1 Census Survey of Displaced Persons and Valuation of Assets

For information of land owners and its value are follows by the Department of the State Land Committee in the Mykolaiv region (letter from 23.02.2011 № 366-1800-714/11, Annex A) on the request of MDA "Ukrpromindustriia".

There is a need to make land acquisition that are in use: 54 agricultural rented land, 6 legal entities of state ownership (military unit A 0224, Odessa railway, operational line management of highways, international airport "Mykolaiv", State Enterprise "Mykolaivlis", Motor roads service in Mykolaiv), 4 legal entities of not state ownership - subjects of enterprenual activity (OJSC "Mykolaiveurodim", LLC "Satellite-hold", LLC "Rodniki" SVT "Lazurne"). Also part of the land needed for the bridge construction, owned by the Mykolaiv city (manager - Mayor of the city). Total number of land owners to be affected by the Project is 65 plots. There is no resident to be resettled because these lands are used only for agricultural business purpose. No illegal resident or squatters are confirmed on these lands in addition.

Resettlement procedure shall be implemented before the start of construction based on the legal.

In terms of bridge construction a list of agricultural lands and legal entities, marked boundaries of the lands are given in the Cartographic materials.(Land on which laid track approaches to the bridge area and areas that are subject to acquisition for the purposes of construction)

Table 6.2.2 Number of Project Affected Units (PAUs) and Affected Persons (APs)

Type of loss	No of PAUs			No of APs		
	Legal	Illegal	Total	Legal	Illegal	Total
Required for displacement (1 – 7)	0	0	0	0	0	0
Not required for displacement						
8 Land owners	65	0	65	0	0	0
9 Wage earners	0	0	0	0	0	0
Grand Total(1-9)	65	0	65	0	0	0

HH: House Hold, CBEs: Commercial and Business Enterprises

Source: department of State land committee in Mykolaiv region

Acquisition land area based on Cartographic materials which is given by State Land Committee is different from the area based on digital map. In this report compensation cost is estimated by the given data from SLC. The reason of difference is not clear, but it is supposed that some plots are not registered correctly. The compensation cost shall be decided based on Detailed Measurement Survey.

A forestation project is not decided.

6.2.3.2 Property and Land

(1) Land

Table 6.2.3 Affected Area by the Project

Land users	Land to be acquired by the project (hectares)		UAH./hectares	Total cost, UAH.
	According to the letter of the State Land committee	According to our calculations	According to the letter of the State Land committee	According to the letter of the State Land committee
Individual farm	60.1	47.6		
Legal entities of private form of ownership	2.3	4.0		
Lands of Forest Fund (and part is not defined)	12.8	12.8		
Lands of auto roads	1.5	1.8		
Lands of city Mykolaiv	12.2	12.2		
Lands of Odessa railway	0.2	0.2		
Lands of international airport "Mykolaiv"	not defined	1.9		
Lands of military unit A 0224	2.0	2.9		
Total Area	**66.3**	**83.4**		
Total cost				

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Source: department of State land committee in Mykolaiv region
(according to the letter dated on Feb 2011)

(2) Structure

There is no structure to be removed.

(3) Product

For agriculture/fish product is not yet surveyed.

6.2.4 Compensation Measures

6.2.4.1 Compensation

Description of compensation and other resettlement assistance will be provided.

Table 6.2.4 Compensation and Other Resettlement Assistance

Necessity of conducting	Procedure,form	Compensatory measures	Source of information on compensation measures	The authority, which controls the activities
Acquisition of land for permanent use	Acquisition of land from individuals	Monetary compensation	Materials of technical-economical justification of the construction a highway river crossing inMykolaiv, the Department of the State Land Committee in the Mykolaiv region (letter from 23.02.2011 № 366-1800-714/11, Annex A)	Mykolaiv Regional State Administration, Department of the State Land Committee in the Mykolaiv region
	Acquisition of land from legal enteties of non governmental sector			
	Allotment of land that are in use state-owned enterprises	Without compensation (because just change of application within the state)		
Acquisition of land for temporary use during construction	Temporary land allocation	Possible partial compensation for individuals and private sector, for government enterprises compensation are not provided	Materials of technical-economical justification of the construction a highway river crossing (areas of land required for temporary use, have finally determined at the subsequent stages of design, namely the construction project)	Mykolaiv Regional State Administration, Department of the State Land Committee in the Mykolaiv region
Acquisition of forest land	Wood –felling (chipping-out)	Target cash compensation for the creation of new green space (afforestation)	Materials of technical-economical justification of the construction a highway river crossing, Letter from State enterprise "Mykolaiv Forestry" від 09.02.2011 р. № 88 (Annex B)	Mykolaiv Regional State Administration, State enterprise "Mykolaiv Forestry"
Selection of water fund lands for the construction of bridge	Selecting and making in kind of coastal protection strips (water protection zones)	Without compensation (because approval of usage by the authority with condition as shown Annex C)	Materials of technical-economical justification of the construction a highway river crossing, The letter from Mykolaiv regional department of water resources from 09.02.2011 № 01-4/114/05/11 (Annex C)	Mykolaiv Regional State Administration, Mykolaiv regional department of water resources

Necessity of conducting	Procedure,form	Compensatory measures	Source of information on compensation measures	The authority, which controls the activities
Land usage by "Ukrzaliznytsia"UZ in the construction of interchange	Easement agreement	Without compensation (at this section planning road designed cross via duct, technical consultation on B/D designe is necessary)	Materials of technical-economical justification of the construction a highway river crossing (coordination of land use "Ukrzaliznytsia" held at the stage of further development of project documentation)	Mykolaiv Regional State Administration, Odessa railway
Reconstruction in communications (transmission lines, pipelines, etc.)	Covering costs of reorganization of communications to their owners. Works by specialized enterprises and organizations	Target cash compensation for construction work on rebuilding communication systems	Materials of technical-economical justification of the construction a highway river crossing (obtain technical conditions for rebuilding and pricing related work performed on the stage of further development of project documentation)	Mykolaiv Regional State Administration, Owners of Communications
Archaeological researches	Coverage of costs for archaeological researches	Target cash compensation for archaeological research findings at the opening – the rest of the money must be spend on the museum	Materials of technical-economical justification of the construction a highway river crossing, Letter of the archaeological rescue services of the Institute of Archaeology NAS of Ukraine from 01.04.2011 p. № 024/11 (Annex D)	Mykolaiv Regional State Administration, Rescue Archaeological Service of the Institute of Archaeology NAS of Ukraine

Responsibility for implementation of compensatory measures, including compensation, under the laws of Ukraine put on a Proprietor of project work, which makes decisions concerning this object. The Proprietor is going to be the State Road Administration in Mykolaiv of Ukraine (Ukravtodor).

6.2.4.2 Entitlement Matrix

Entitle Matrix for resettlement is shown in Table 6.2.5.

Table 6.2.5 Entitle Matrix

Item No.	Type of loss	Entitled Persons (Beneficiaries)	Entitlement (Compensation Package)	Implementation issues/Guidelines	Responsible Organization
1.	Loss of agricultural land, pond, ditches and orchards etc.	Legal owner(s) of land	i Replacement value of land (Cash Compensation under Law and additional grant to cover the market value of land at market price to be determined by Expert.	a. Assessment of quantity and quality of land by SRA b. Assessment of Cash Compensation under Law (SLC) c. Updating of title of the affected persons (SLC) d. Payment of Cash Compensation under Law (SRA) e. APs will be fully informed of the entitlements and procedures regarding payments f. compensation for land	a. SRA b. SLC c. MRA d. GRC
2.	Loss of commercial plots by owners/Authorities	Legal owner(s) of the land	〃	〃	
3.	Loss of Trees	i. Person with Legal Ownership of the land ii. Socially recognized owner/ Unauthorized occupant of the trees/ fishes	〃	〃	〃
4.	Loss of business by CBEs due to dislocation	Owner/operator of the business as recorded by JVS	〃	〃	〃
5.	Loss of access to Residential houses/ commercial structures (Owners/rented or leased)	Tenants of rented/ leased properties	〃	〃	〃

6.2.5 Frame Work of Institutional Responsibility for Land Acquisition

6.2.5.1 Institutional Responsibility

Framework of Institutional responsibility for land acquisition is shown in Figure 6.2.1.

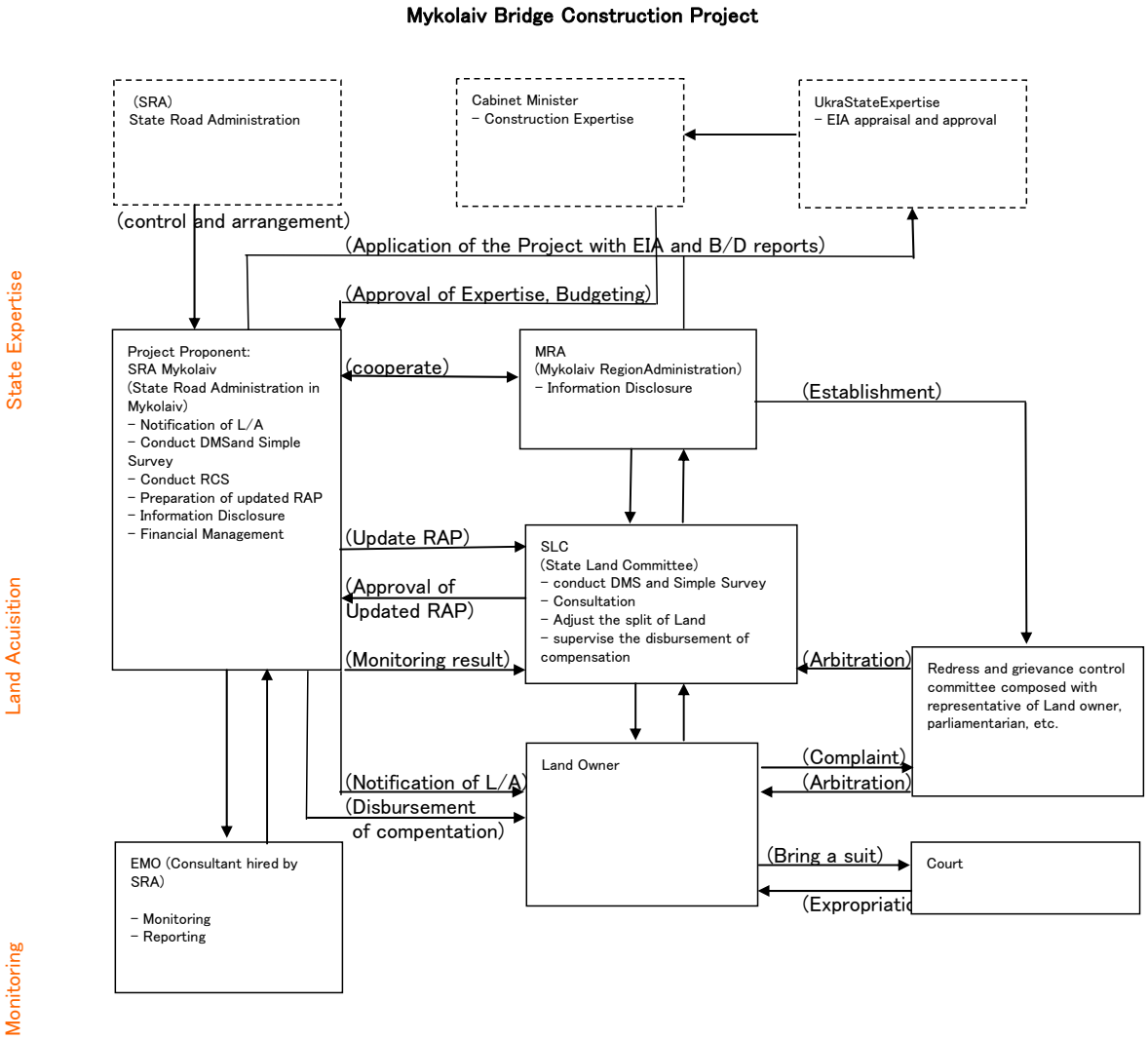

Figure 6.2.1 Institutional Responsibility for Land Acquisition

6.2.5.2 Grievance and Redress Mechanism

Redress mechanism on grievance is also shown in Figure 6.2.1

6.2.6 Schedule of Land Acquisition

A timetable and budget Compensation Framework as of F/S stage.

Schedule of land acquisition is shown table below and compensation summary is shown in Table 6.2.6 and Figure 6.2.2.

Table 6.2.6 Schedule of Key Activities of Land Acquisition

Activities	Target dates/time
1. Land Acquisition schedule	
1.1. Application of Ukra State Expertise of the Project (with EIA including preliminary RAP (and B/D))	November 2011
1.2. Approval of Ukra State Expertise	June 2012
1.3. Notification of Land Acquisition (Declare of cut-off Date)	June 2012
1.4. Conduct the DMS	July 2012
1.5. Conduct the Replacement Cost Survey (RCS)	July 2012
1.6. Preparation of updated RP	June to August 2012
1.7. Approval of the updated RP (by Mykolaiv Regional Administration)	December 2012
1.8. Information disclosure of the updated RP (Consultation meetings)	On and after December 2012
1.9. Consultation of Land Price (if a Land Owner does not agree)	On and after December 2012
1.10. Bring a suit (if a Land Owner does not agree after consultation)	On and after December 2012
1.11. Land clearance	October– December 2014

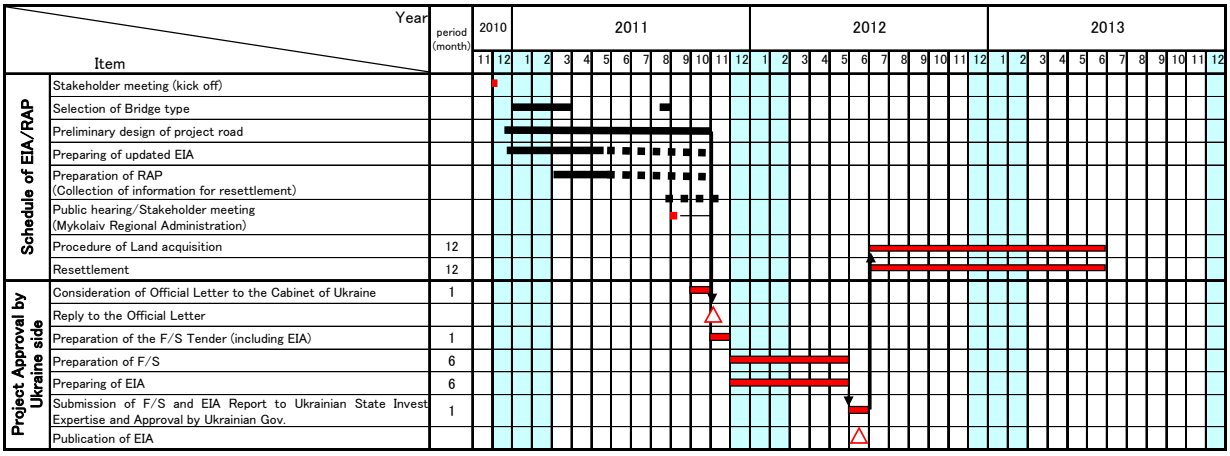

Figure 6.2.2 Schedule of EIA/Land Acquisition

6.2.7 Cost and Fund

Project cost and fund are estimated as of F/S stage.

Table 6.2.7 Compensation Summary

Stage	Parameter of compensation activities	Deadline	Approximate budget, mln hrn.	Source and funds manager
1	2	3	4	5
1. Acquisition of lands for construction needs, which are owned by the State	Regulatory assessment of land	During 1 year before construction		Targeted funds allocated from the state budget of Ukraine, on a special bank account. Proprietor of construction (Ukravtodor)
2. Acquisition of land that are in municipal ownership	Compensation for loss of agricultural and forestry production			
3. Acquisition of lands for construction needs, which are owned by the City	Regulatory assessment of land			
4. Purchase of land that are in use of entrepreneurs	The agreed price in accordance with the owners of expert money valuation			
5. Purchase of land that are in use of individuals	The agreed price in accordance with the owners of expert money valuation			
6. forced land acquisition (by the court decision)	The cost of land according to expert estimation			
7. Carrying out preparatory work to provide compensatory measures	Aarcheological investigations	During construction		
	Anti-landslide and erosion preventive works			
	Cutting of greenery			

Source: Letter from State Land Committee, Mykolaiv

Cost of the plot of land to be assigned or transferred into ownership instead of the assigned one, shall be defined under agreement on the grounds of its expert monetary evaluation performed in accordance with the legislation, such as Resolution of the Cabinet of Ministers of Ukraine of 19 April, 1993 No. 284 "On Procedure for Calculation and Compensation of Losses to Land Owners and Land Users". Explanation of legislation contents is shown in Table 6.2.8.

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Table 6.2.8 explanation of compensation procedure

Category	Explanation	Compensation price, thousand of UAH /hectare, by type of use	Justification of price (provision on the price justification or how the price is determined)
Farming land	Pre-design or preceding the resettlement market price which is of equal potential performance capability or use, which is near to the land which is influenced by the project plus cost of the land preparation to the level similar to the land level which is influenced by the project plus cost of any expenses on registration or taxes on transfer of immovable property.	from 3,0 thousand of UAH up to 35,0 thousand of UAH	Approximate cost is determined by weighted average of data of regulatory monetary valuation of farming land of Nikolayev region.
Land in municipal; zone	Preceding the resettlement market price of the land of equal dimensions and use with similar or improved public facilities of infrastructure and services which are located near with the land which is influenced by the project, plus cost of any expenses on registration or taxes on transfer of immovable property.	from 400,0 thousand of UAH up to 1500,0 thousand of UAH	Weighted average of data of results of the performed expert evaluation of the plots of land within borders of city of Nikolayev region subordination

Source: Letter from State Land Committee, Mykolaiv

Estimated land acquisition costs are shown in Table6.2.9. Land acquisition area has differences between the data of the letter from SLC and surveyed map. Total compensation costs, estimated by SLC, are also shown in Table 6.2.9.

After the approval of “Ukrexpertise” that will appraise the project on the basis of the EIA and other basic design reports, land acquisition and compensation procedures such as detailed measurement survey will start within three months.

Table 6.2.9 Estimated Land acquisition area and compensation cost for the project

Land users	Land to be acquired by the project (hectares)		UAH./hectares	Total cost, UAH.
	According to the letter of the State Land committee	According to our calculations	According to the letter of the State Land committee	According to the letter of the State Land committee
Individual farm	60.1	47.6		
Legal entities of private form of ownership	2.3	4.0		
Lands of Forest Fund (and part is not defined)	12.8	12.8		
Lands of auto roads	1.5	1.8		
Lands of city Mykolaiv	12.2	12.2		
Lands of Odessa railway	0.2	0.2		
Lands of international airport "Mykolaiv"	not defined	1.9		
Lands of military unit A 0224	2.0	2.9		
Total Area	**66.3**	**83.4**		
Total cost				

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Source: compiled data based on Letter from State Land Committee, Mykolaiv

6.3 Public Consultation

During survey period, two times of stake Holder Meeting was held as shown in Table 6.3.1.

Table 6.3.1 list of Stakes Holder Meetings

No.	Date	Venue	No. of participant	Object
1	1/12/2010	Mykolaiv Regional Administration	27	Explanation of the Project Question and Answer session
2	9/9/2011	Mykolaiv Regional Administration	20	Project abstract, Opinion for Environmental Impact

The meeting as of September, 9 2011 is introduced in local paper and URL is as follows.

http://novosti-n.mk.ua/news/read/?id=33441

http://is.park.ru/doc.jsp?listno=2169477&listcd=1&listmd=5&listfile=pub&urn=49444509

Main points at issue and answer from the organizer are as follows.

- Environmental issues on the Project site are clear at the point of EIA in 2004.
- Land owners of the project site basically agreed to buy out the land during work group established in 2007.
- Compensation for residual land by split of land may be caused by the Project, but actual compensation means are not decided as of now. But, SRA Mykolaiv has many experience of land rearrangement in the other road construction project.

Minutes of Meeting on Public Consultations are shown in Appendix 7.

CHAPTER 7

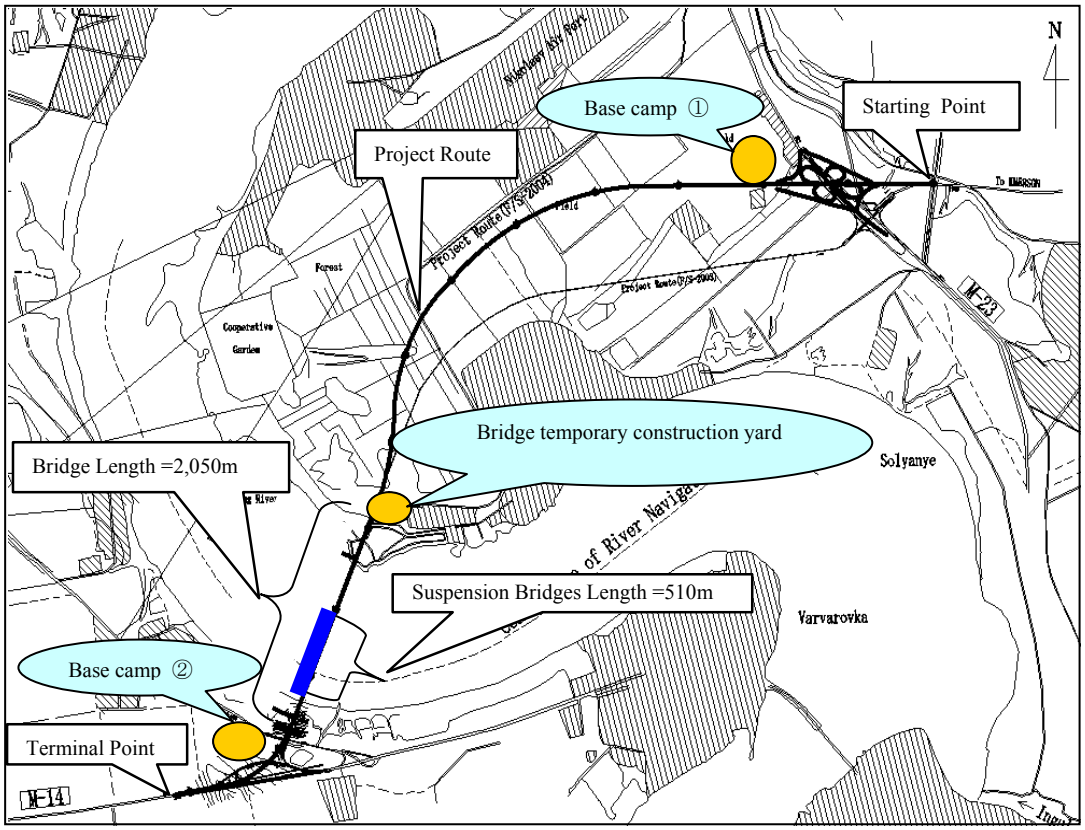
CONSTRUCTION AND PROCUREMENT PLAN

7. CONSTRUCTION AND PROCUREMENT PLAN

7.1 Construction Plan

7.1.1 Preliminary Execution Plan

Project road total length is 13.2km. This project consists of construction of a 2,050m long bridge (510m of suspension bridge and 1,540m of approach bridges), 11.2km of access road (1.6km on the right-bank side and 9.6km on the left-bank side) and interchange ramps (8 on the starting point side and 3 on the terminal point side). The project route and temporary construction yard position are shown in the following figure.



Source: JICA Survey Team

Figure 7.1.1 Project Route and Temporary Construction Yard Plan

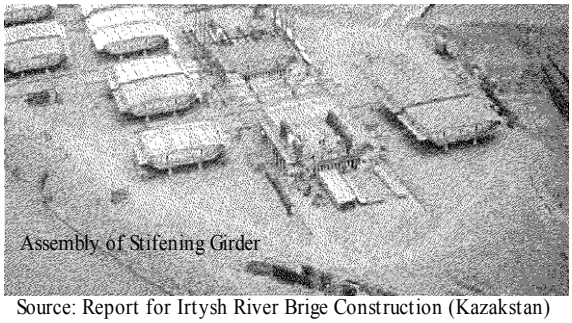
(1) Assembly and Temporary Storage Yard for Suspension Bridge Stiffening Girders

The proposed site of the assembly and temporary storage yard for suspension bridge stiffening girders is shown in the following figure.

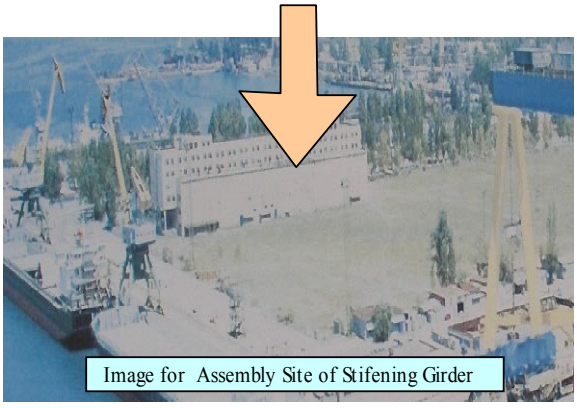
As shown in the figure below, the following three sites are considered for the assembly and temporary storage yard: The reasons for selection of the three sites are as follows.

- The three proposed sites have harbour facilities that can dock large vessels. Moreover, a large site (50m x 50m) can stock materials for assembly and temporary storage.
- When carrying and unloading a lot of material for stiffening girder fabrication from domestic and overseas using vessels, these sites are close to the project site.

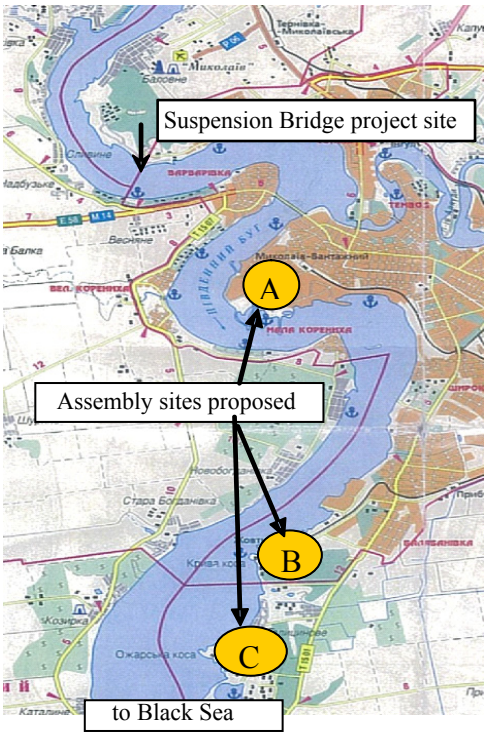
After stiffening girders are manufactured, it is planned to carry them by river barge to the bridge construction site.



Source: Report for Irtysh River Brige Construction (Kazakstan)



Source: Mykolaiv city Information Photo



Source: JICA Survey Team

Figure 7.1.2 Proposed Sites of Assembly and Temporary Storage Yard for Suspension Bridge Stiffening Girders

7.1.2 Construction Method for Mykolaiv Bridge

As described in Chapter 5, Mykolaiv Bridge construction consists of the main bridge (suspension bridge) and approach bridges. Each bridge type is as follows.

- Suspension bridge with 510m centre span and 810m bridge length as the main bridge over the waterway.
- Steel I girder with 45m center span and 1,540 total length as the approach bridges

The construction method for each is outlined below.

(1) Construction Method for Suspension Bridge

The construction outline for the suspension bridge is divided into the following construction work: temporary work, foundation work, tower work, and superstructure

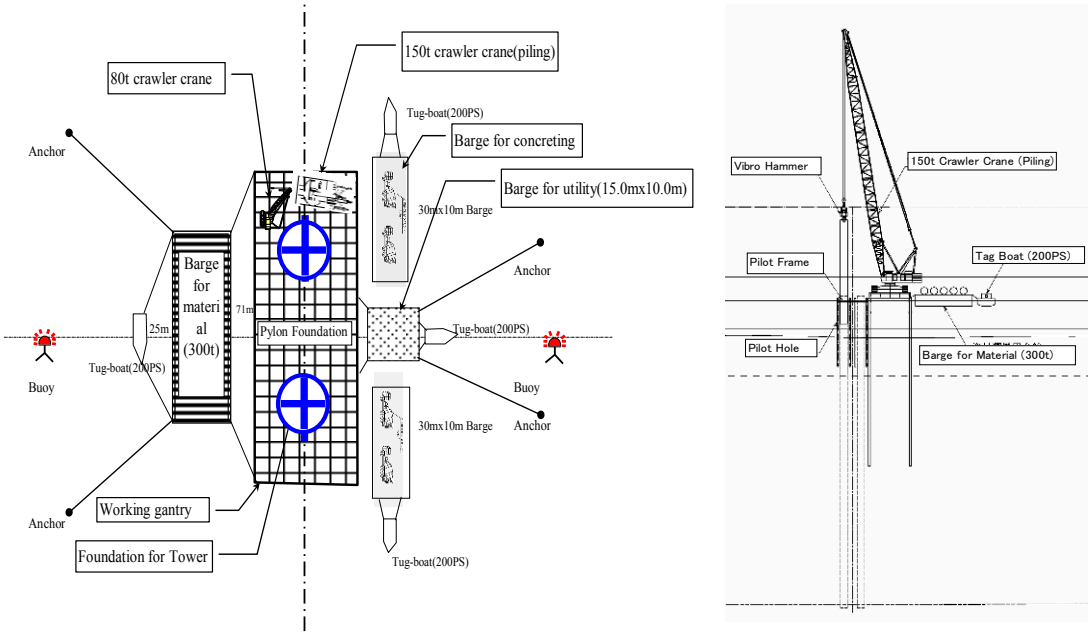
1) Temporary Work

Suspension bridge work in the river (main tower foundations and anchorage foundation works) will be conducted upon constructing work barges. Tugs will be used to carry heavy machinery and materials onto the barges. Figure 7.1.3 shows the layout of the main barges and machinery.

2) Foundations

Foundation works on the main tower and anchorage will comprise the steel pipe sheet pile (SPSP) foundation method which was selected in Chapter 5.

Figure 7.1.3 shows the schematic drawing of construction.

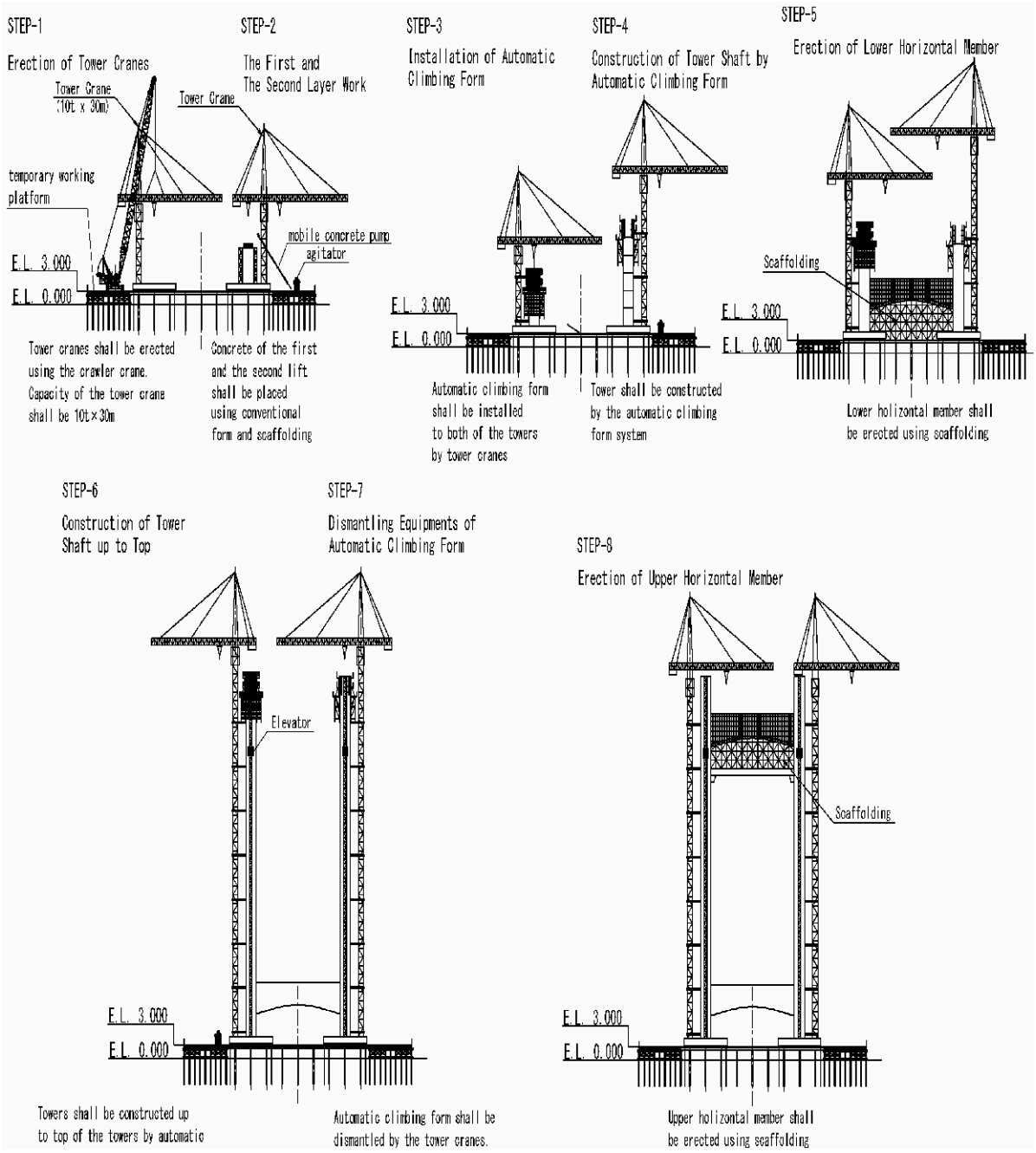


Source: JICA Survey Team

Figure 7.1.3 Construction Planning for Foundations

3) Towers

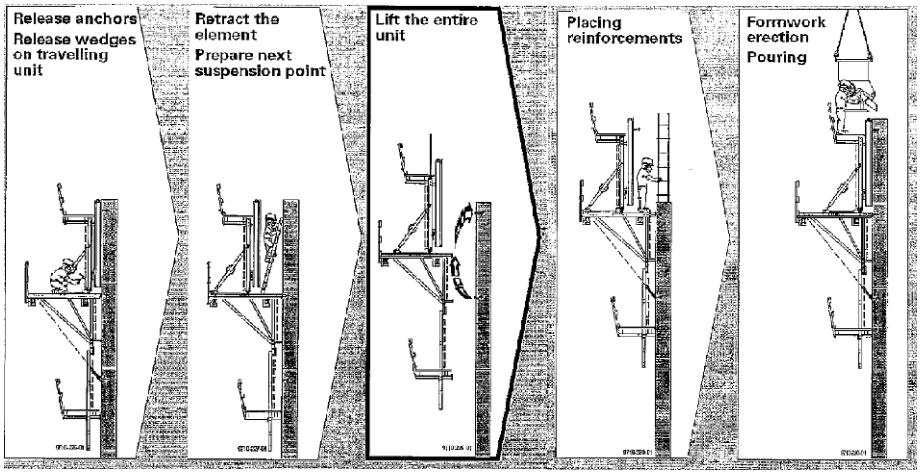
Concrete mixer trucks will be loaded onto the work barges to supply raw concrete to the work sites in the river. Concrete will be cast by bucket using a concrete pump or tower crane. The tower construction planning flow is shown below.



Source: JICA Survey Team

Figure 7.1.4 Tower Construction Planning Flow

Of special note is that the jumping form method will be adopted for construction of the tower building frames. This entails building an automatic elevator into the formwork that is integrated with the scaffold. Specifically, the cast-in-place concrete tower structure is constructed through repeatedly lifting the formwork.



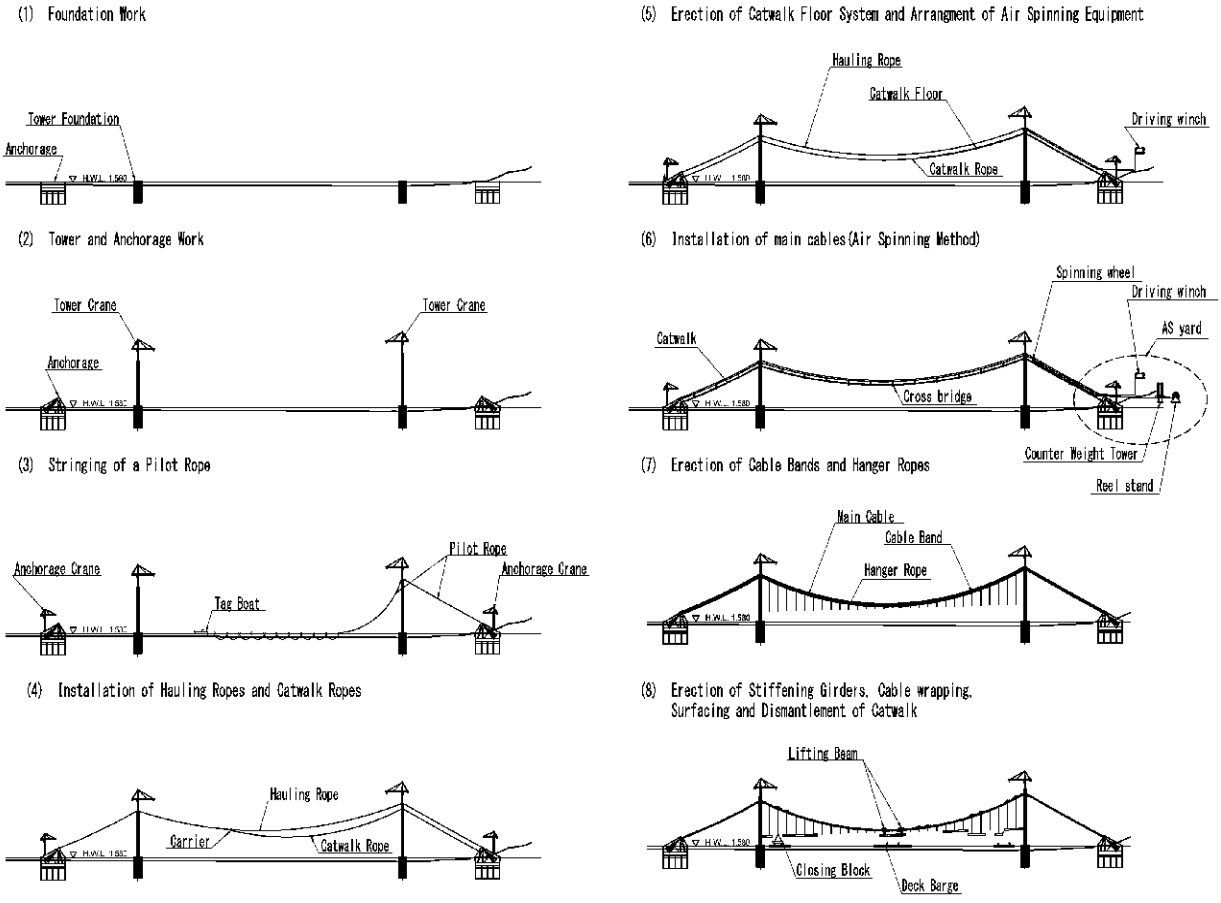
Source: JICA Survey Team

Figure 7.1.5 Jumping Form Construction Method

4) Construction outline of the superstructure for the suspension bridge

The construction outline and procedure for the superstructure of the suspension bridge are shown in the following figure.

The construction procedure for the main cable construction and stiffening girders is outlined in detail on the following page.



Source: JICA Survey Team

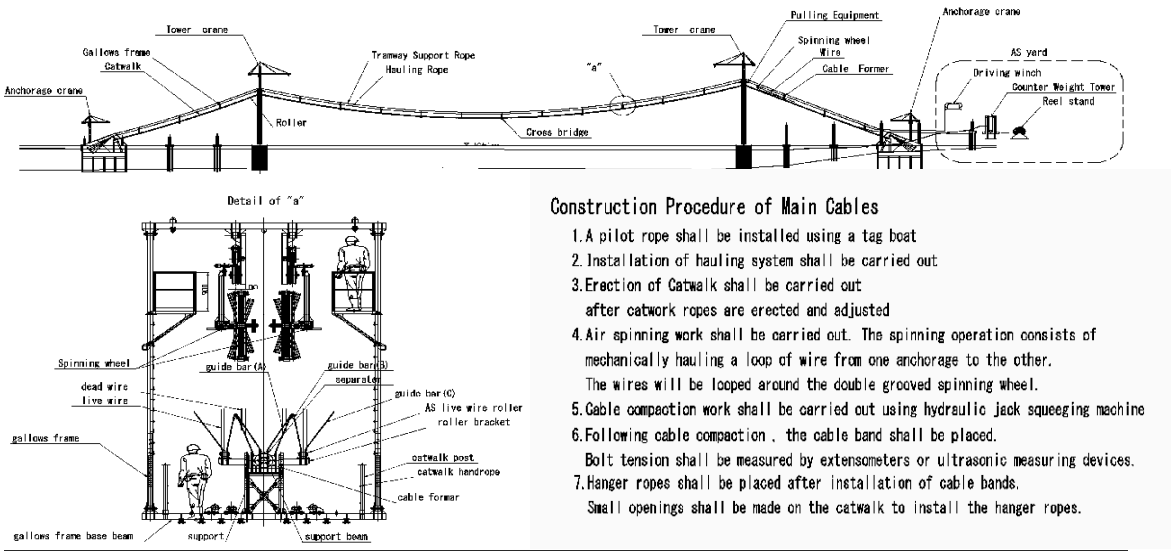
Figure 7.1.6 The Construction Flow of Superstructure

a) Construction of main cable

The air spinning method (AS) is planned for the main cables. .

This entails installing the cables aboveground by spinning one cable wire at a time. The yard for AS cables is located on the right bank (on shore).

The construction procedure for suspension bridge cables is shown in the following figure.

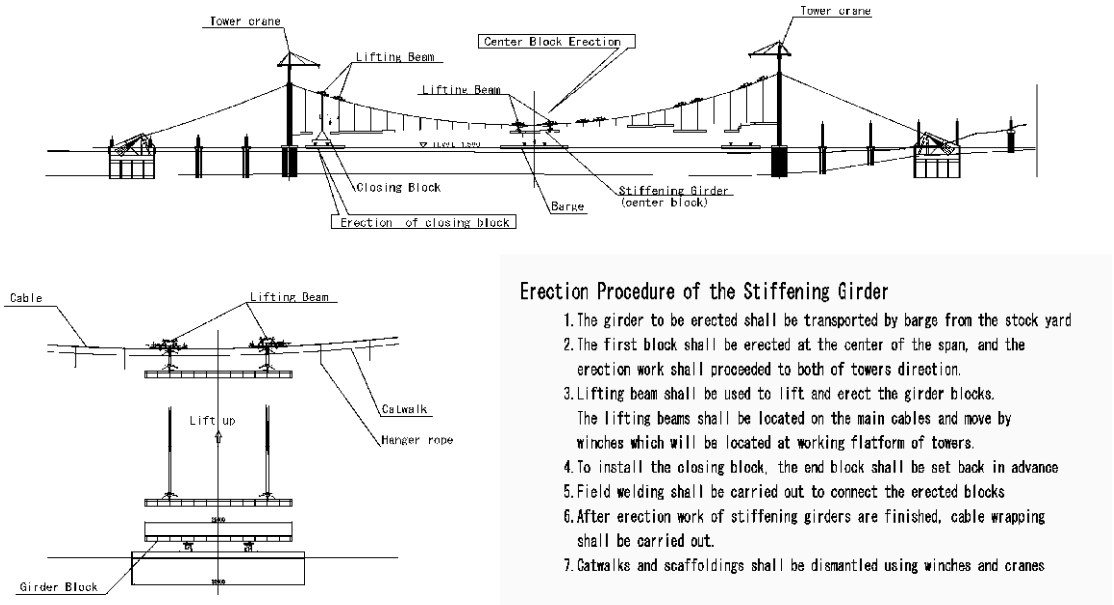


Source: JICA Survey Team

Figure 7.1.7 Construction Procedure for Main Cables

b) Erection of stiffening girders

Stiffening girders will be manufactured at the proposed downstream temporary yards as shown in 7.1.1 (1). Then they will be put on barges and carried to the site. Erection procedure for the stiffening girders is shown in the following figure.



Source: JICA Survey Team

Figure 7.1.8 Erection Procedure for Stiffening Girders

(2) Construction Method for Approach Bridges

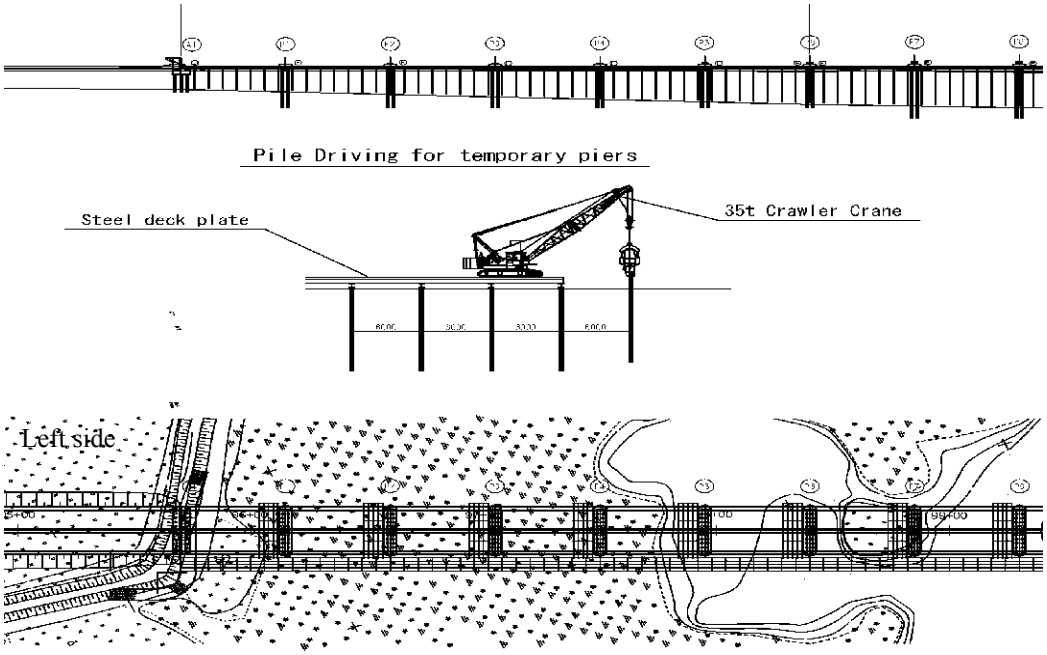
For the approach bridges, Steel I-girder type with prestressed concrete slabs has been selected as described in 5.6.3.

The construction outline for the approach bridges is divided into the following construction work: temporary work, foundation work, substructure work, and superstructure

1) Temporary works

Regarding the temporary works, it is planned to build temporary piers in shallow areas where barges cannot be used.

The temporary piers will be constructed for carrying materials and equipment and directly conducting work in the case of conducting approach bridge works (foundation work, substructure work, and superstructure work) from the left bank. The following figure gives a schematic view of the work.



Source: JICA Survey Team

Figure 7.1.9 Construction Planning of Temporary Bridge

2) Foundation

The steel pile method selected in Chapter 5 and entailing transport of equipment and materials over a temporary pier is planned for the footing foundations.

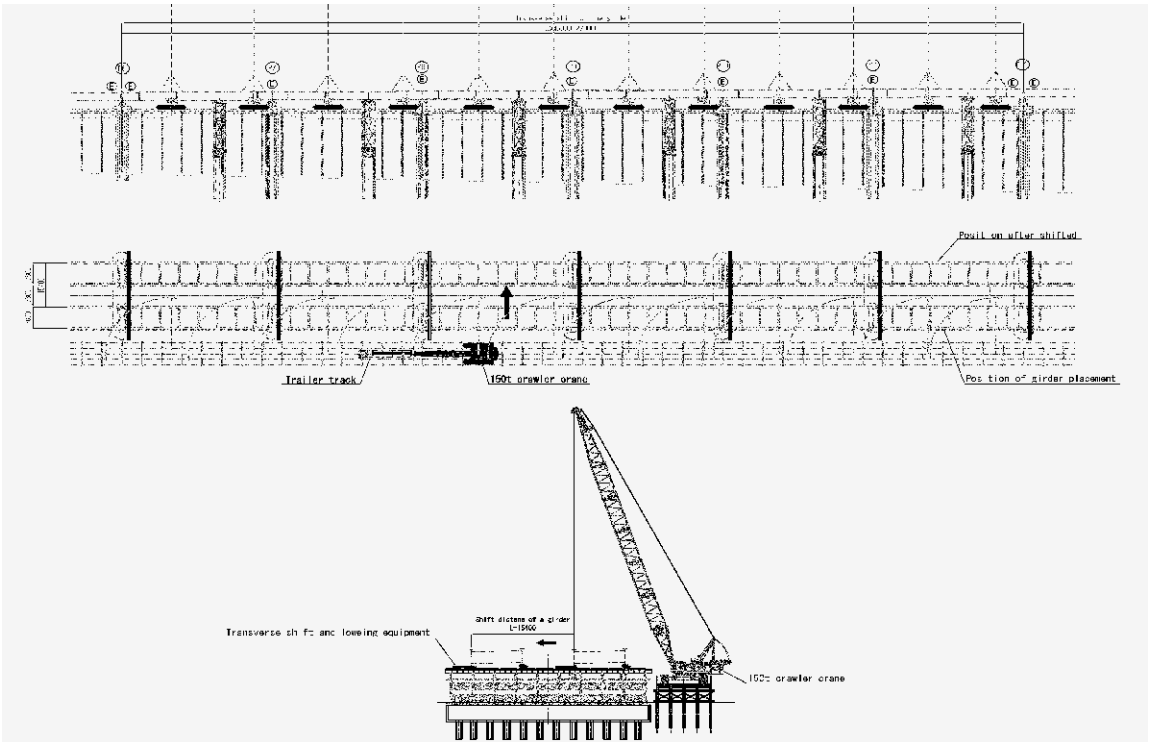
As was described in 7.1.2 (1) 2), foundation works will be executed using a crawler crane (150t) and vibro hammer.

3) Substructure

Substructure (abutments and piers) will be constructed by transporting equipment and materials over a temporary jetty from the land. As for the building frame, cast-in-place concrete placing will be conducted.

4) Erection method (left bank)

The steel main girders will be constructed from the pier by crawler crane (150t) as shown in the figure. In constructing the structure, bents will be inserted between piers.

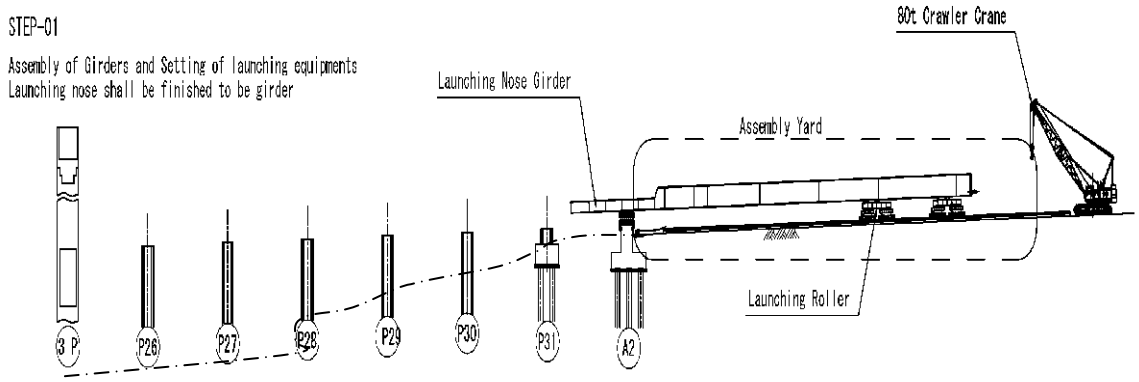


Source: JICA Survey Team

Figure 7.1.10 Bent Erection Method using Crawler Crane

5) Erection method (right bank)

Regarding construction of the Steel I-girders from the right bank to the tower (3P), as shown in the following figure, since work by self-propelled crane is not suited to this section due to the inclined terrain, the launched construction method from behind the abutment shall be adopted.

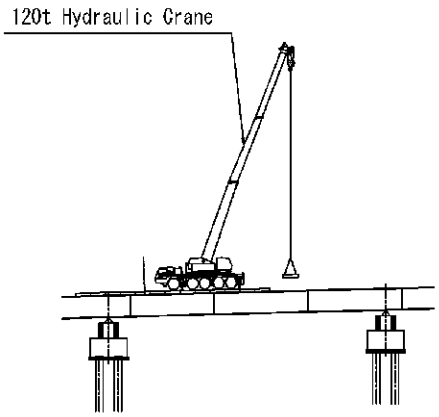


Source: JICA Survey Team

Figure 7.1.11 Erection by the Launched Construction Method

6) Installation of precast deck

Construction of prestressed concrete slabs is conducted in the bridge axis direction using a wheel crane (120t) after girder erection, as shown in the following figure.



Source: JICA Survey Team

Figure 7.1.12 Placement of PC Slabs using a Wheel Crane

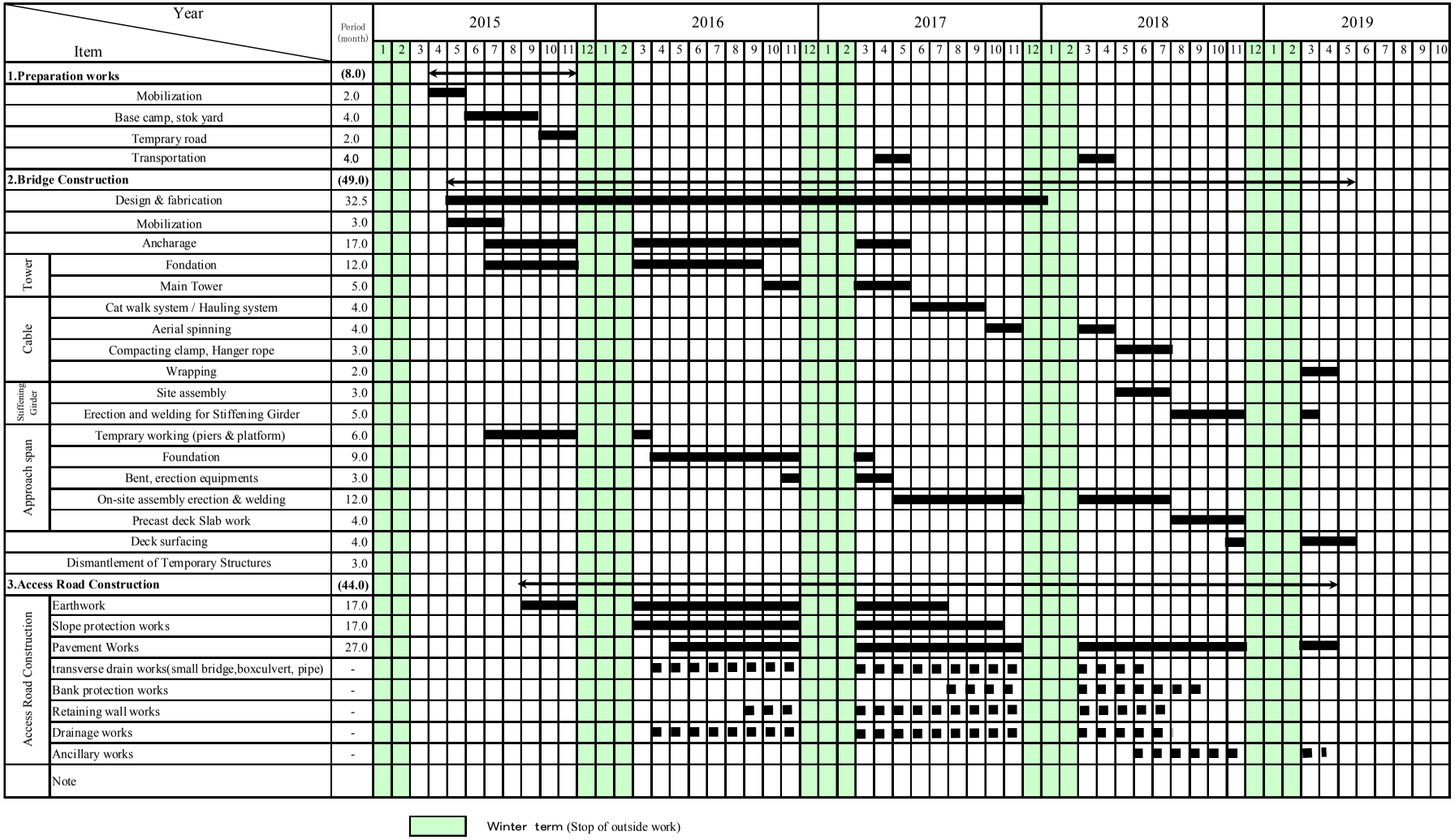
7.1.3 Construction Schedule

In construction schedule planning, the number of potential work days was calculated upon examining the work quantities, procedures and critical path and taking local climate into account.

Regarding climate, the winter freeze period (three months from December to February) is not included in the work term because outdoor work will be impossible at this time.

The construction schedule is shown in the following table.

Table 7.1.1 Construction Schedule



Source: JICA Survey Team

7.2 Procurement Plan

7.2.1 Procurement Plan for Main Materials

Main materials for construction of the suspension bridge are shown in Table 7.2.1. Some of the main materials, such as steel, cement, aggregates and sand can be procured from the domestic market; on the other hand, some of the other materials, such as high tension steel and concrete additives will be imported from European countries or other foreign countries, depending on a contractor.

Table 7.2.1 Procurement Plan for Main Materials (Tentative)

Material	Country to be Procured	Remarks
Gasoline	Local	From markets in Ukraine
Diesel	Local	From markets in Ukraine
Natural Gravel	Local	Domestic product
Graded Crashed Stone	Local	Domestic product
Coarse Aggregate	Local	Domestic product
River Sand	Local	Domestic product
Asphalt Prime Coat	Local	From markets in Ukraine
Bitumen	Local	From markets in Ukraine
Portland Cement	Local	Domestic product
Plywood	Local	Domestic product
H-Shaped Steel	Local	Domestic product
Reinforcement Bar	Local	Domestic product
Steel Pipe Casing	Local	Domestic product
Sheet Pile	Local	Domestic product
Steel Plate	Local	Domestic product
PC Strand	Foreign	From foreign markets
Main Cable	Foreign	From foreign markets
Cable Band	Foreign	From foreign markets
Hanger Cable	Foreign	From foreign markets
Rubber Bearing	Foreign	From foreign markets
Expansion Joint	Foreign	From foreign markets
Scaffoldings	Local	Domestic product

Source: JICA Survey Team

7.2.2 Procurement Plan for Labour and Equipment

(1) Labours for Consultant

Some foreign expertise and technicians, as well as local engineers, are assumed to be necessary for supervising the bridge and road construction work as shown in Table 7.2.2.

The foreign expertise will be mainly in charge of the suspension bridge and the local engineer will be mainly in charge of the approach bridges and road as well as assisting the foreign expertise.

Table 7.2.2 Mobilization Plan for Engineers (Tentative)

Title	Experience	Country to be Procured
Team Leader	22 years or more	Foreign Expertise
Deputy Team Leader/ Structure Engineer	18 years or more	Foreign Expertise
Bridge Superstructure Engineer	13 years or more	Foreign Expertise
Bridge Substructure Engineer	13 years or more	Foreign Expertise
Highway Engineer	13 years or more	Foreign Expertise
Drainage Engineer	8 years or more	Foreign Expertise
Topographical Survey Engineer	8 years or more	Foreign Expertise
Soil Material Engineer	8 years or more	Foreign Expertise
Electric /Mechanical Engineer	8 years or more	Foreign Expertise
Cost Estimator	13 years or more	Foreign Expertise
Document Specialist	13 years or more	Foreign Expertise
Environmental Specialist	13 years or more	Foreign Expertise
Traffic Survey Specialist	8 years or more	Foreign Expertise
Deputy Team Leader/ Structure Engineer	18 years or more	Local Engineer
Bridge Superstructure Engineer	13 years or more	Local Engineer
Bridge Substructure Engineer	13 years or more	Local Engineer
Highway Engineer	13 years or more	Local Engineer
Soil Material Engineer	8 years or more	Local Engineer
Electric Engineer	8 years or more	Local Engineer
Topographical Survey Engineer	8 years or more	Local Engineer
Cost Estimator	8 years or more	Local Engineer
Document Specialist	8 years or more	Local Engineer
Quantity Engineer	5 years or more	Local Engineer
System Engineer	5 years or more	Local Engineer
Resettlement Engineer	5 years or more	Local Engineer
Environment Engineer	5 years or more	Local Engineer
CAD Operator	5 years or more	Foreign Expertise

Source: JICA Survey Team

(2) Equipment

Most equipment for construction work is available from local contractors in Ukraine although some special equipment such as those for erection of the main cables shall be temporarily imported. This temporary imported equipment is to be demobilized and sent back to the original country in order to ensure import tax exemption. Table 7.2.3 shows some examples of main equipment to be mobilized for this project.

Table 7.2.3 Mobilization Plan for Main Equipment (Tentative)

Equipment	Specification	Country to be Procured
Bulldozer 15 ton	136 PS	Local
Bulldozer 32 ton with ripper	314 PS	Foreign
Excavator 1.1m^3 (0.8)	169 PS	Local
Tractor Shovel 1.8-1.9m^3	152 PS	Local
Wheel Loader 1.5-1.7m^3	110 PS	Local
Motor Grader blade 3.4 m	137 PS	Local
Dump Truck 10 ton	334 PS	Local
Road Roller Macadam 12 ton	76 PS	Local
Pneumatic Tire Roller 8-20 ton	97 PS	Local
Vibrating Roller 7-8.5 ton	105 PS	Local
Crawler Crane 50-55 ton	179 PS	Local
Crawler Crane 100 ton	277 PS	Local
Truck crane 25 ton	220 PS	Local
Tower Crane 90t.m B=24m	45 kW	Local
Barge for concreting and utilities	15m×10m	Local
Tag boat	200 PS	Local
Erection System for Cable	for main cable	Foreign
Erection System for Girder	for stiffening girder	Foreign
Elevator 2 ton	30 kW	Local
Vibration Hummer	60 kW	Local
Vibration Hummer for Rock Pile	120 kW	Local
All Casing Pile Machine D=2000 mm	392 PS	Foreign
Concrete Plant 60m^3/hr	91kW	Local
Asphalt Plant 30 ton/hr	120 kW	Local
Agitator Truck 4.4-4.5m^3	290 PS	Local
Concrete Pump (boom) 90-110m^3	271 PS	Local
Asphalt Finisher 2.4-4.5 m	53 PS	Local
Air Compressor 5m^3	53 PS	Local
Power Generator 10 kVA	18 PS	Local
Power Generator 45 kVA	57 PS	Local
Power Generator 200 kVA	265 PS	Local
Welder 300A Diesel	22 PS	Local

Source: JICA Survey Team

CHAPTER 8

PROJECT IMPLEMENTATION AND OPERATION PLAN

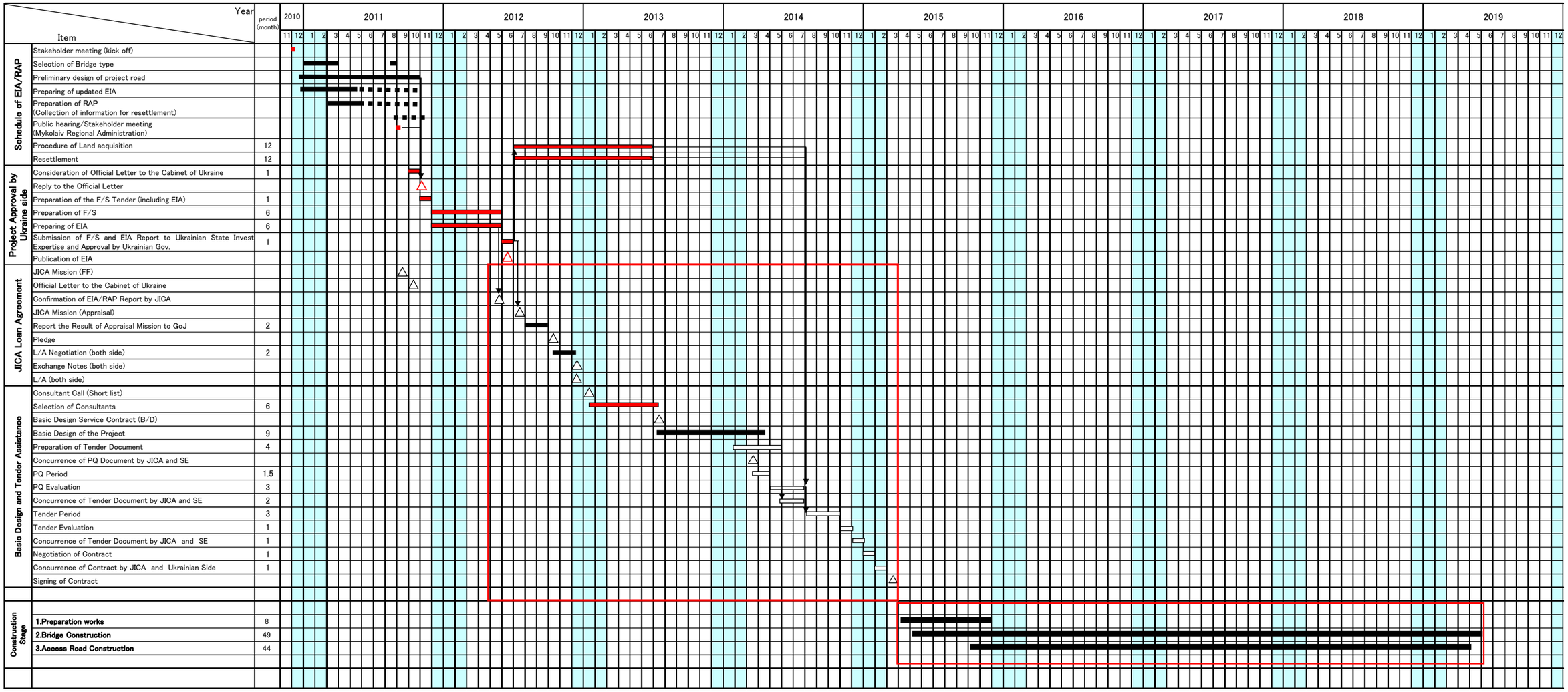
8. PROJECT IMPLEMENTATION AND OPERATION PLAN

8.1 Project Implementation Plan

Figure 8.1.1 shows the tentative project implementation plan which includes all necessary procedures for project implementation. As shown in the Figure, the Feasibility Study stage (project documentation) shall follow this preparatory survey in order to get approval from the Ukrainian Cabinet prior to getting into the Detailed Design stage and tendering stage. Total construction stage will last 4 years and 2 months considering site closure of 3 months of every year in winter.

Project Implementation Plan (Draft)

	Item	period (month)
Schedule of EIA/RAP	Stakeholder meeting (kick off)	
	Selection of Bridge type	
	Preliminary design of project road	
	Preparing of updated EIA	
	Preparation of RAP (Collection of information for resettlement)	
	Public hearing/Stakeholder meeting (Mykolaiv Regional Administration)	
	Procedure of Land acquisition	12
	Resettlement	12
Project Approval by Ukraine side	Consideration of Official Letter to the Cabinet of Ukraine	1
	Reply to the Official Letter	
	Preparation of the F/S Tender (including EIA)	1
	Preparation of F/S	6
	Preparing of EIA	6
	Submission of F/S and EIA Report to Ukrainian State Invest Expertise and Approval by Ukrainian Gov.	1
	Publication of EIA	
JICA Loan Agreement	JICA Mission (FF)	
	Official Letter to the Cabinet of Ukraine	
	Confirmation of EIA/RAP Report by JICA	
	JICA Mission (Appraisal)	
	Report the Result of Appraisal Mission to GoJ	2
	Pledge	
	L/A Negotiation (both side)	2
	Exchange Notes (both side)	
	L/A (both side)	
Basic Design and Tender Assistance	Consultant Call (Short list)	
	Selection of Consultants	6
	Basic Design Service Contract (B/D)	
	Basic Design of the Project	9
	Preparation of Tender Document	4
	Concurrence of PQ Document by JICA and SE	
	PQ Period	1.5
	PQ Evaluation	3
	Concurrence of Tender Document by JICA and SE	2
	Tender Period	3
	Tender Evaluation	1
	Concurrence of Tender Document by JICA and SE	1
	Negotiation of Contract	1
	Concurrence of Contract by JICA and Ukrainian Side	1
	Signing of Contract	
Construction Stage	**1.Preparation works**	8
	2.Bridge Construction	49
	3.Access Road Construction	44



Source: JICA Survey Team

Figure 8.1.1 Implementation Plan

8.2 Structure for Project Implementation

8.2.1 Implementation Agency

The road sector in Ukraine is under the jurisdiction of the State Road Administration (SRA or UKRAVTODOR) of Ukraine. SRA was established in 2001 based on the Decree of the President of Ukraine 2001/No.628 and his role and power is clearly described in the Decree of the Minister of Ukraine 2007/No.628 in 2007. SRA is the state governing body of automobile roads, whose activities are directed and coordinated by the Cabinet of Ministers of Ukraine, and supervised by the Ministry of Transportation and Communications.

The total length of streets and highways in Ukraine is 438,500km. Among them, SRA manages roads with a total length of 169,500km, including important national roads of 20,000 km and 16,000 bridges with a total length of 364km. SRA will also be the execution agency for this Project with cooperation of the Ministry of Finance and Department of Economic Affairs of Ukraine.

The main roles of SRA are to develop recommendations for the government policy on road management, the state transport network programs and management strategy, and to provide a reliable and safe road system, improvement and development of road economy and to control the organizations and companies involved in construction, reconstruction, repair, and maintenance for the roads as shown in Figure 8.2.1. The budget of SRA in 2009 was 16,700 million UAH, 9,800 million UAH was reimbursement for a loan and 3,900 million UAH was the expenditure for the repair and reconstruction of the roads.

SRA is a recipient of donor assistance, namely from the European Bank for Reconstruction and Development (EBRD), International Bank for Reconstruction and Development (IBRD) and European Investment Bank (EIB). For example, SRA has been managing the following projects.

1. IBRD Project "Improvement of road traffic routes and traffic safety" Kiev, Poltava regions (project implementation period: 2009 – 2012).

2. IBRD and EIB Third Project "Repair of the automobile road Kiev-Chop" (project implementation period: 2010 – 2011).

3. IBRD and EIB "Improvement of road service quality at approach roads to Kiev City" (project implementation period: 2011-2015).

4. EBRD Project 1-3 "Restoration of Trunk Road M-06 at the section Chop town -Striy town", "Continuation of Restoration of the trunk road M-06 at the section Striy town – Brody town" and "Restoration of M-06 at the section of Brody town - Zhitomir town"

5. EBRD "Improve to European level automobile road M-03 Kiev-Kharkov-Dovjanskiy at the section from Boryspol town (km44_500) to Lubny town (km 191+400） " (corresponding to national transport corridor Europe-Asia)

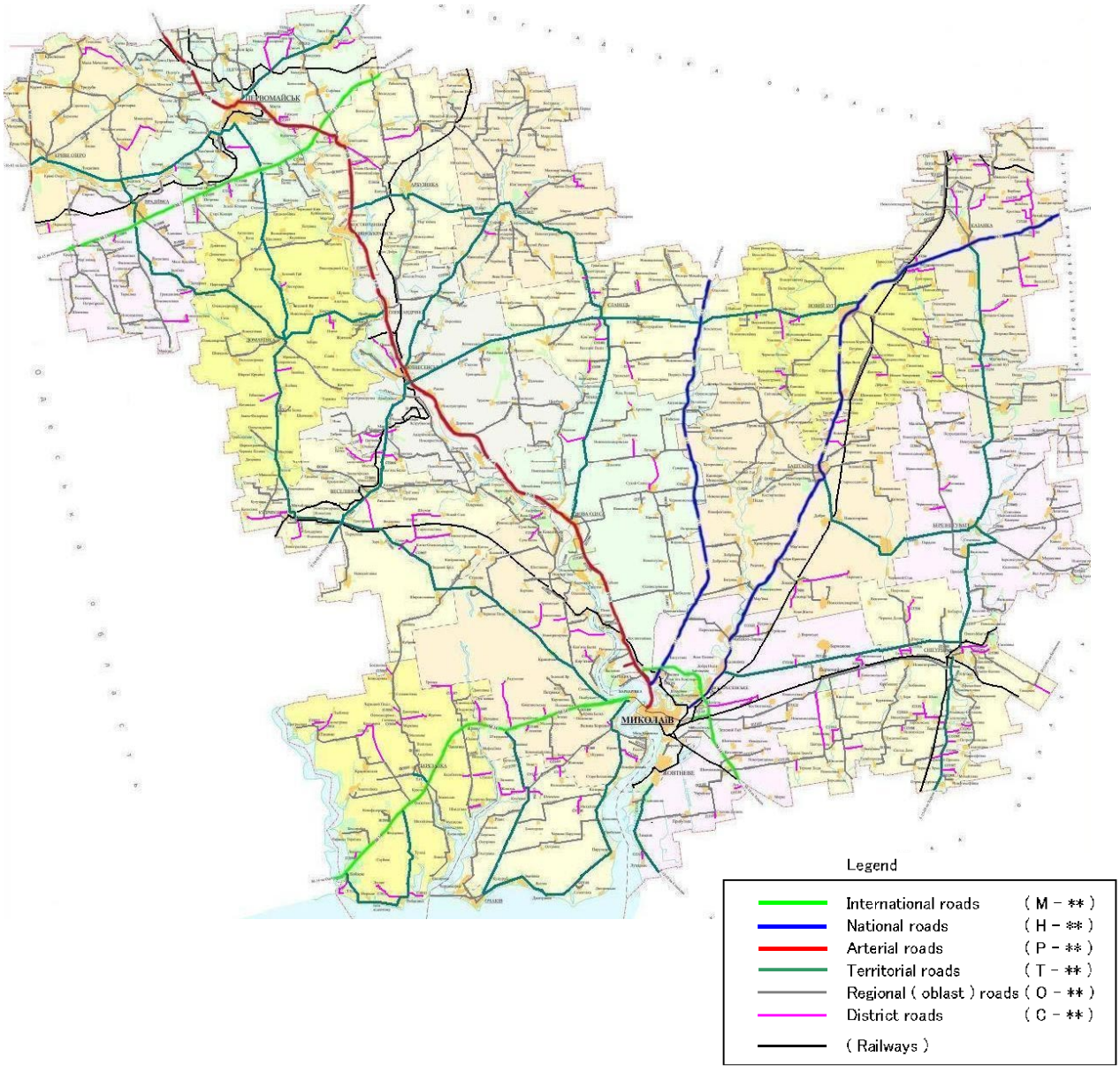
The Structure of SRA is shown in Figure 8.2.2.

There are many Joint Stock Companies under the umbrella of SRA such as the State Road Research Institute MP Shulgin (Derzhdor NDI), State Enterprise "State Scientific-Technical Center Quality Inspection and Certification of Road production" (DP Dor'yakist), State Enterprise "Survey of Traffic Service", State Enterprise "Ukrainian Road"(Ukdorinvest), etc, that carry out a wide range of tasks.

On February 28, 2002 by Presidential order, the State Joint Stock Company "Ukrainian Motor Road (Avtomobilni dorohy Ukrainy: ADU)" was established as a company involved in construction, repair and maintenance work for motor roads. ADU consists of 32 daughter-companies in each oblast, Crimea, and the cities of national importance. The annual budget of ADU is around 4 billion UAH (at the end of 2000s).

- SRA Mykolaiv branch office

SRA Mykolaiv branch office manages almost roads in Mykolaiv region. Total length of roads is 4776km on September 2011.Management work includes maintenance for existing roads and construction of new roads. But roads in Mykolaiv city are controlled by the municipality of Mykolaiv city. Road network map and length of roads managed by SRA Mykolaiv branch office are shown Figure 8.2.1 and Table 8.2.1.



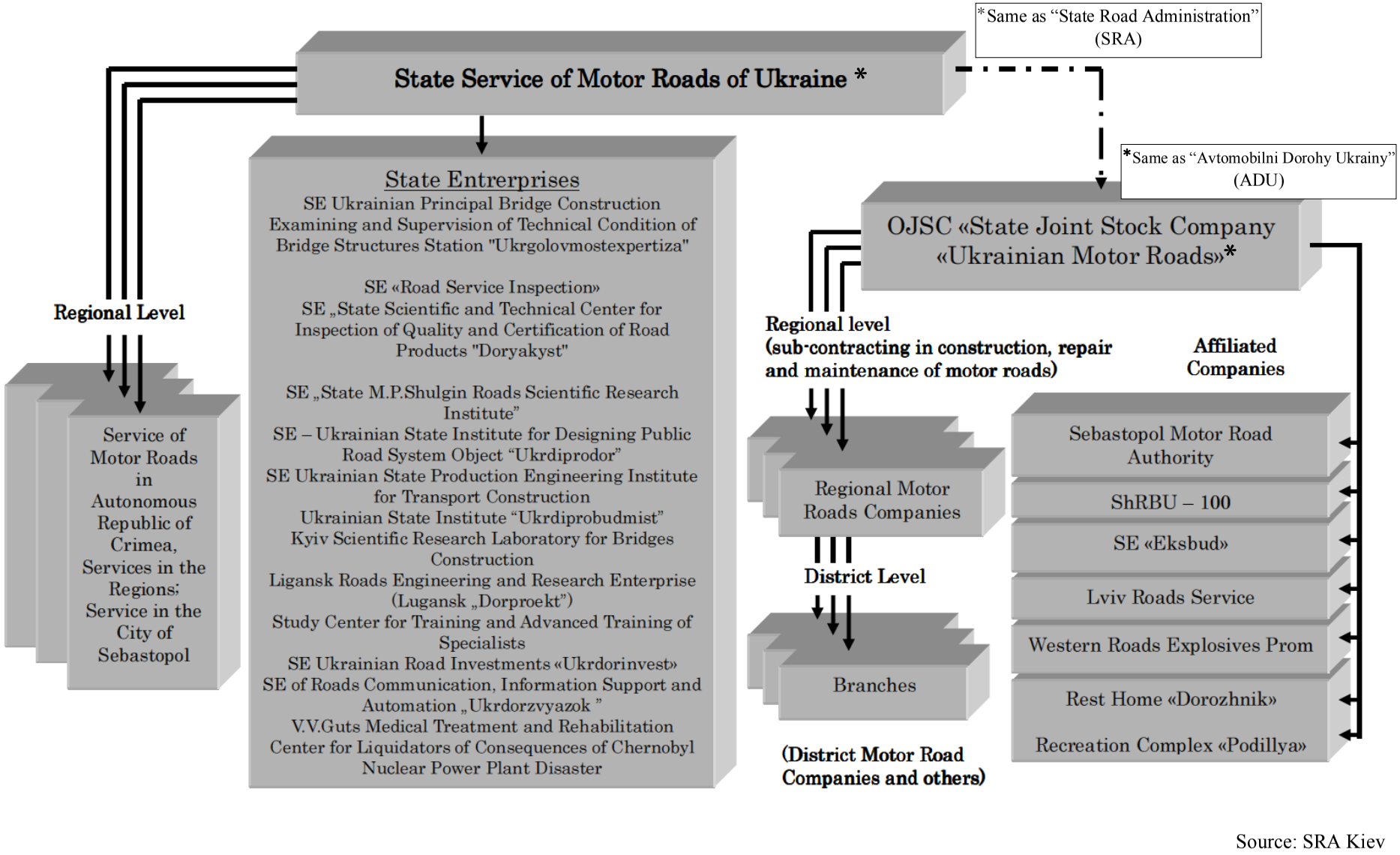
Source: SRA Mykolaiv

Figure 8.2.1 Road network managed by SRA Mykolaiv

Table 8.2.1 Length of Roads managed by SRA Mykolaiv

Name of roads	Total length of roads (km)	among them with hard pavement (km)	(%) Pavement road ratio	among them upon pavement types							Road sections with hard pavement upon the category				
				improved payment			transitional pavement			unpaved					
				cement concrete	asphalt concrete	bituminous macadam road	"White road"	stone paving	bituminous		I	II	III	IV	V
International roads (M)	194.0	194.0	100%	82.1	111.9	0	0	0	0	0	6.7	105.2	82.1	0	0
National roads (H)	225.9	225.9	100%	0	222.7	3.2	0	0	0	0	10.6	156.3	55.8	3.2	0
Arterial roads (P)	174.9	174.9	100%	2.2	172.7	0	0	0	0	0	34.1	67.2	62.4	11.2	0
Totally of state value	**594.8**	**594.8**	**100%**	**84.3**	**507.3**	**3.2**	**0.0**	**0.0**	**0.0**	**0.0**	**51.4**	**328.7**	**200.3**	**14.4**	**0.0**
Territorial roads (T)	968.1	968.1	100%	6.4	339.3	596.6	23.3	2.5	0	0	0	121.7	406.3	440.1	0
Regional(oblast) roads (O)	2566.7	2565.0	99.9%	8.0	349.9	1392.3	742.7	72.1	0	1.7	0	18.8	84.7	2461.5	0
District roads (C)	646.2	633.8	98.1%	0	84.8	253.6	288.9	6.5	0	12.4	0	0	0	633.8	0
Totally of local value	**4181.0**	**4166.9**	**99.7%**	**14.4**	**774.0**	**2242.5**	**1054.9**	**81.1**	**0.0**	**14.1**	**0.0**	**140.5**	**491.0**	**3535.4**	**0.0**
Total	**4775.8**	**4761.7**	**99.7%**	**98.7**	**1281.3**	**2245.7**	**1054.9**	**81.1**	**0.0**	**14.1**	**51.4**	**469.2**	**691.3**	**3549.8**	**0.0**

Source: SRA Mykolai



Source: SRA Kiev

Figure 8.2.2 Diagram of Management of Roads Complex of Ukraine

Some of the long span bridge projects in recent years are shown in Table 8.2.2.

Table 8.2.2 Long Span Road Bridges in Ukraine

Name of the Bridge	Length of the Bridge	Main Span of the Bridge	Number of Lanes	Completion Year
1. Zaporizhzha Bridge across the Dnieper River	4,484 m	260 m (Cable Stay Bridge)	6	Under Construction
2. Kiev Podol Bridge across the Dnieper River	7,100 m	344 m (Steel Arch Bridge)	6	Under Construction
3. Cable Bridge in the Odessa Port	150.5 m	114.7 m (Cable Stay Bridge)	2	1998
4. Kiev Southern Bridge across the Dnieper River	1,228 m	271 m (Cable Stay Bridge)	6	1992
5. Kiev Moscow Bridge across the Dnieper River	779 m	300 m (Cable Stay Bridge)	6	1976

Source: MOSTBUD Company Brochure

8.2.2 Consultant and Contractor

Availability of a local design consultant and contractor for large bridges was stated in the Feasibility Study Report in 2004 done by local consultants, Kievsojuzdoproject, as follows:

> While the national bridge-building industry has certain experience in the design and construction of highway bridges with cable-stayed girder structures, suspended bridges with such large girders have never been in the territory of CIS. An exception is a bridge across the river Irtysh (Kazakhstan) built in 2001 with the main girder being 750m long, but designed and constructed by Japanese specialists.

It is also confirmed from the local consultant that this situation has not been changed since 2004.

Mostbud, a local contractor, is the only prime contractor for large scale bridge projects in Ukraine. They have outstanding experience with bridges in Ukraine and other CIS countries, and still admit that they do not have any experience with suspension bridges.

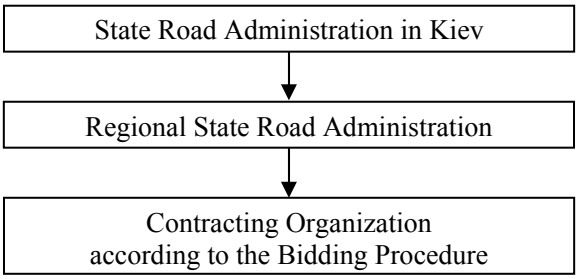
As stated in section 5, a suspension bridge is the appropriate type for the Mykolaiv Bridge. Therefore it is recommended to adopt international tender for procurement of consultants and contractor(s) considering the lack of experience with suspension bridges among local consultants and contractors in Ukraine. In addition, support by the consultant, who carried out preliminary design, will be necessary for the local consultant who has the responsibility to implement basic design (project documentation) to get approval from concerned Ministries, and after that, from the Cabinet of Ministers of Ukraine.

8.3 Structure for Operation and Maintenance

8.3.1 Current Situation of the Operation Agency

The State Road Administration (SRA) of Ukraine is an execution agency of road projects, and is also responsible for repair and maintenance of state roads and bridges as shown in Figure 8.3.1. Maintenance and repair work of roads and bridges by SRA is governed by an official maintenance manual, namely, “DBN V.3.1-218-190-2004, Maintenance of Bridges on General Highways”.

State Enterprise Ukrainian Road Investments (UKRDORINVEST) is a responsible agency for project implementation, operation and maintenance for high standards motor way including loan projects financed by International Development Bank, such as M-03 and M-06, and appoints directors for Project Implementation Unit (PIU) as shown in Figure 8.3.2. It is assumed that the same structure will be applied for implementation Mykolaiv Bridge Project.



Source: JIA Survey Team

Figure 8.3.1 System of Road Maintenance Work

In Mykolaiv Region, roads under the maintenance of SRA are kept in relatively good condition compared to the roads maintained by Mykolaiv City. SRA doesn't have their own maintenance machinery and materials because a contracted company has a responsibility for such machinery and materials.

8.3.2 Budgetary Allocation for SRA

The following table shows the budgetary allocation for Repair and Maintenance work of SRA for the last five years. Since 2006, maintenance budget is getting larger than the previous years and greater than repair budgets in recent years.

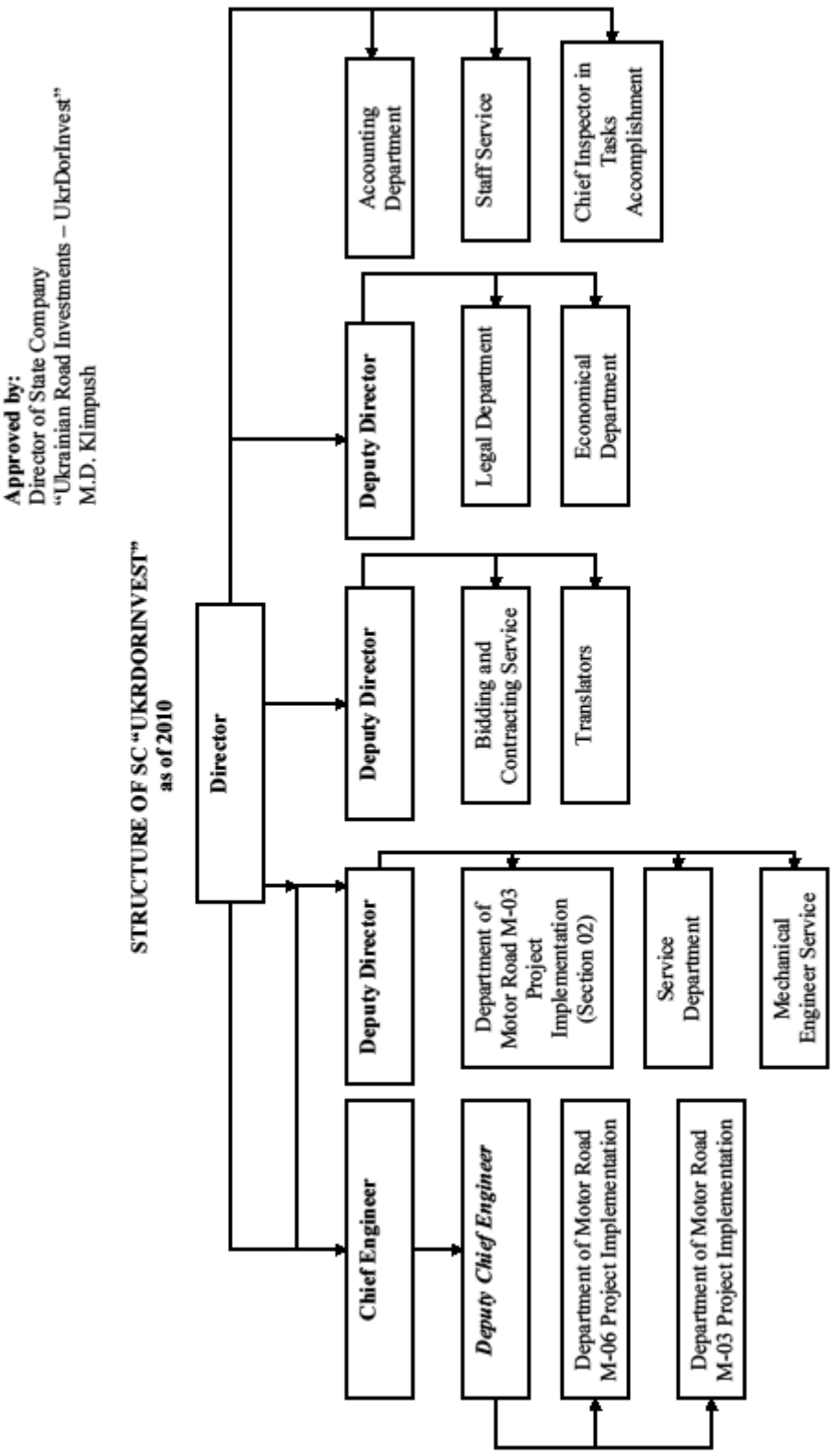
Table 8.3.1 Budgetary Allocation for SRA

Unit: mil. UAH

	2006		2007		2008		2009		2010	
	SRA (All)	SRA (Mykolaiv)	SRA (All)	SRA (Mykolaiv)	SRA (All)	SRA (Mykolaiv)	SRA (All)	SRA (Mykolaiv)	SRA (All)	SRA (Mykolaiv)
Repair	1,219	53	1,550	45	2,147	46	1,893	28	1,292	174
Mainte-nance	1,015	31	1,343	39	1,565	49	2,051	72	2,310	84
Total	2,234	84	2,894	84	3,712	95	3,944	100	3,602	258

Source: SRA Mykolaiv

In Ukraine, following the extension of new state roads, maintenance cost is increasing. However, bridge maintenance is generally not good and sometimes no maintenance work is applied. In such cases, bridge condition is getting worse day by day and immediate maintenance work is necessary for some of the long bridges.



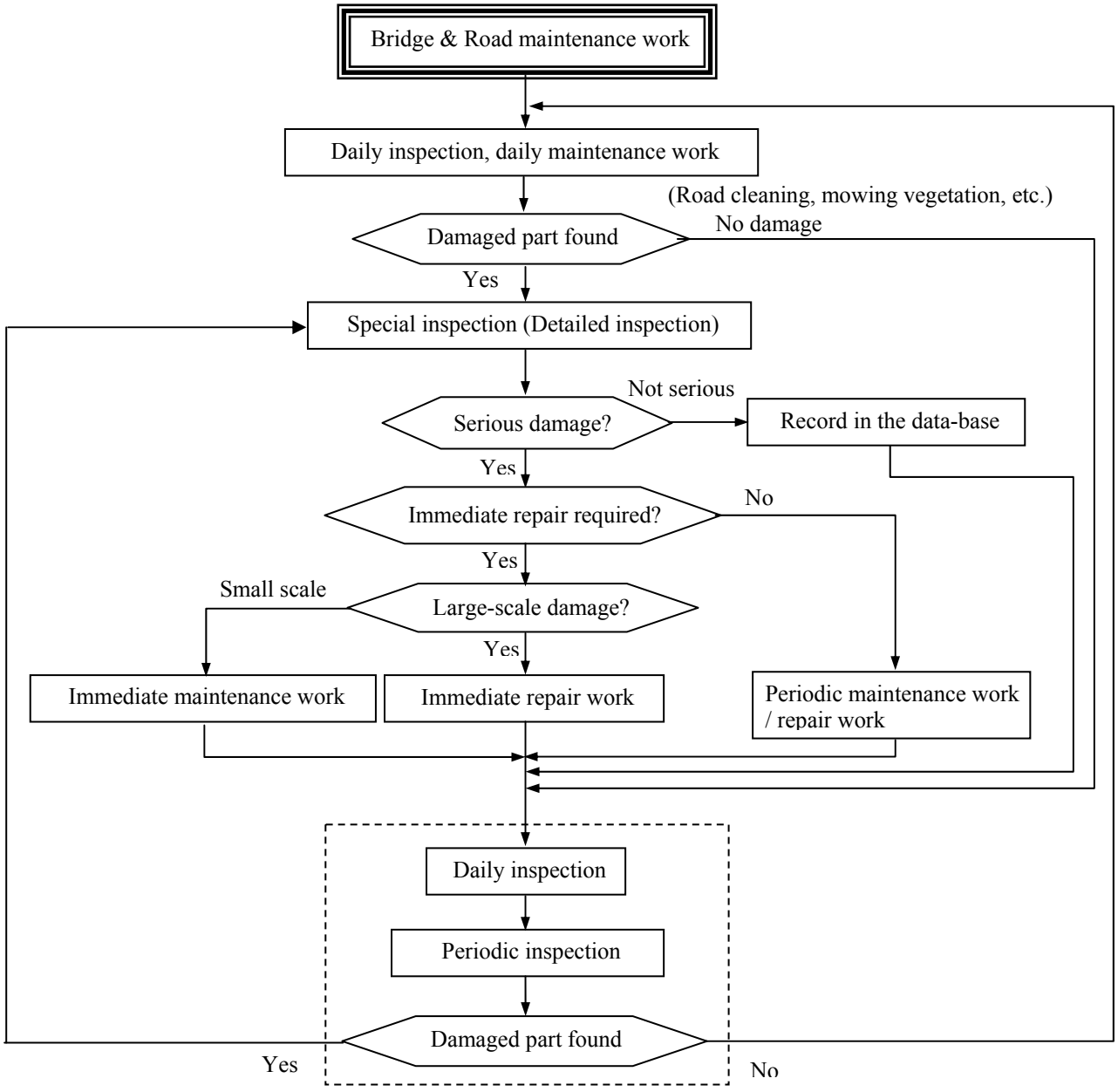
Source: SRA Kiev

Figure 8.3.2 Structure of UKRDORINVEST

8.3.3 Required Level for the Operation Agency

(1) Maintenance System for Bridges and Roads

In order to maintain roads and bridges properly, maintenance work needs to be implemented in a quality controlled manner, and the organization for the work must be capable of achieving all types of tasks required for the maintenance. Figure 8.3.3 is the flowchart of a general and overall maintenance system for a road.



Source: JIA Survey Team

Figure 8.3.3 Maintenance System

(2) Administration System for Maintenance

Maintenance of roads requires various tasks including inspection, maintenance and repair. Some tasks require immediate measures and some require appropriate measures without hindering the traffic at any time.

For smooth achievement of the tasks, care should be taken of the following.

- Complete communication and information network between the maintenance administrative body and the road maintenance office (local agency)
- Clear responsibility sharing between the road maintenance office and the machinery/material suppliers and maintenance service firms

Official or private firms should be employed extensively for large-scale maintenance work but the following must be taken into account.

- Establishment of monthly and yearly maintenance schedule
- Preparation of maintenance manual
- Preparation of guidelines for an open tender, work management and inspection
- Education on the importance of road maintenance

(3) Database and Management System

Preparation of a database and a management system is indispensable for road maintenance. The most important thing in preparing a database is to collect and store reliable data, in particular, design reports, completion drawings, specifications, and job records. Repair history should also be included.

(4) Elements and Tasks of Bridge and Road Maintenance

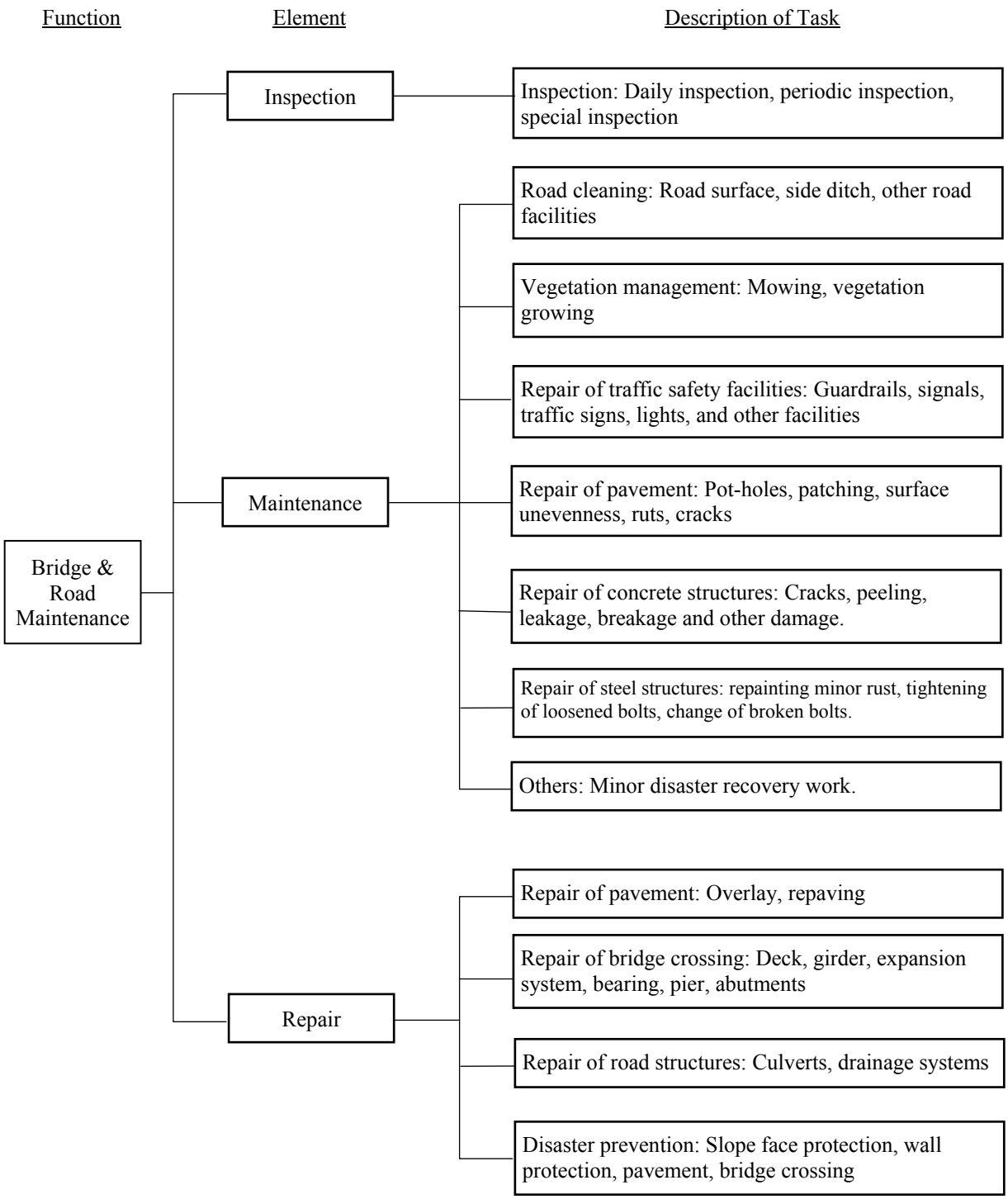
Figure 8.3.3 shows the elements and tasks of bridge and road maintenance.

(5) Safety Measures in Road Maintenance

In carrying out road maintenance, careful attention shall be paid to traffic rules, traffic safety and traffic conditions. Necessary traffic control personnel should be arranged for the duration of the maintenance to ensure the safety of the road users and the maintenance workers and not to hinder smooth traffic flow.

(6) Traffic Control Means

Date, time zone and procedure of the maintenance and necessary traffic control shall be examined in view of the traffic volume, number of lanes and availability of a bypass route.



Source: JIA Survey Team

Figure 8.3.4 Elements and Tasks of Bridge and Road Maintenance

(7) Observed Activity of Maintenance Work for Roads and Bridges

1) Maintenance Work for Roads

During the preparatory survey, maintenance works for roads, i.e., repair/reconstruction of asphalt surfacing, were occasionally observed on the route between Kiev, Mykolaiv and Odessa.

Maintenance activity of surfacing work is shown in Figure 8.3.5 as an actual activity.

Figure 8.3.5 Maintenance work between Mykolaiv and Odessa on M14, May 2011.

Maintenance system for Roads in Ukraine (UKRVTODOR) seems not be well implemented.

2) Maintenance Work for Bridges

Bridge maintenance works seems to be rarely implemented in Ukraine. Followings are observed corrosion, deterioration and defect of the bridges.

Figure 8.3.6 Breakage of waterproof cover for the stay cables (Moscow Br. Kiev)

Figure 8.3.7 Corrosion of steel girder (Moscow Br. Kiev)

Figure 8.3.8 Corrosion of steel girder (Cable Stayed Bridge, Kiev)

Figure 8.3.9 Deterioration/Defect of unsafe side walk (PC girder located at 90km upstream from Mykolaiv)

Figure 8.3.10 Deterioration of Curb (PC girder located at 90km upstream from Mykolaiv)

Figure 8.3.11 Surfacing on the steel deck of Ingul bridge in Mykolaiv

CHAPTER 9

PROJECT COST ESTIMATION

9. PROJECT COST ESTIMATION

9.1 Estimated Costs

(1) Compensation Cost

Following costs are estimated at the Preconstruction Stage.

- Land acquisition
- Resettlement of utilities
- Protection of utilities

No resettlement of houses and industrial structures are observed at the project site, although there are some old warehouses and an asphalt plant which are not used because of aging.

(2) Construction Cost

Costs at Construction Stage are estimated in BQ (Bill of Quantities) bases as shown in Table 9.1.1 considering the consistency of "Technical Specifications" to be prepared in the Basic Design stage. Some indirect costs, such as contractor's administration cost, which shall be appropriately distributed and added on each "Pay Item", are also calculated as individual item at this Preliminary Design stage.

(3) Engineering Cost

Following costs are estimated as the Engineering Cost of each stage.

- Basic Design Cost
- Tender Assistance Cost
- Construction Supervision Cost

(4) Operation and Maintenance Costs

Operation and maintenance costs shall include re-painting of the bridge and replacement of expansion joints and shoes.

Table 9.1.1 Bill of Quantities for the Project

Item No.	Description	Unit	Quantity
SECTION 1 - PRELIMINARY AND GENERAL			
1.1	Preliminary and General	ls	1
SECTION 2 - SITE CLEANING			
2.1	Clearing and Grubbing	sq.m.	683127
SECTION 3 - EARTH WORK			
3.1	**Excavation**		
301(1)	Excavation for Classified Material (including Soft Rock) for Reuse (Excavation/Loading/Transport)	cu.m.	1,123,203
3.2	**Embankment and Other Areas of Filling**		
302(1)	Fill for Road-bed of Embankment - Using Excavated Soil (including Soft Rock) in Other Part (Placing & Spreading/Compaction)	cu.m.	1,067,043
302(2)	Fill for Road-bed of Embankments - Using Borrow Material (Excavation/Loading/Transport/Placing & Sp	cu.m.	488,449
303(3)	Slope Formation - Cut Slope	sq.m.	96,241
304(4)	Slope Formation - Filling Slope	sq.m.	183,049
305(5)	Subgrade with Selected Material (Excavation/Loading/Transport/Placing & Spreading/Compaction)	cu.m.	111,420
302(6)	Slope Covering	cu.m.	41,894
302(7)	Embankment Turfing	sq.m.	310,091
SECTION 4 - DRAINAGE			
4.1	**Pipe Culvert**		
401(1)	Pipe Culvert D=1500mm	m	850
4.2	**Ditches**		
402(1)	Type Side Ditch（W=0.6m)	m	23406
402(2)	Type Side Ditch（W=2.0m)	m	8270
402(3)	Type Shute Ditch	m	370
402(4)	Type Median Ditch	m	1000
4.4	**Catch Basin**		
404(1)	Catch Basin	nr.	122
4.5	**Underground Ditch**		
405(1)	Underground Ditch	m	2440
SECTION 5 - INCIDENTALS			
5.1	**Greenery Works**		
501(1)	Informal Hedge Trees	nr.	2044
	Road Furniture		
5.2	**Guard Rail**		
502(1)	Guardrail (Road Side) - Gr - 4.0	m	15088
502(2)	Median Cable Barrier	m	11476
5.3	**Traffic Signs**		
503(1)	Traffic Sign Board - Rectangle Variable Dimension	nr	11
5.4	**Road Marking**		
504(1)	Road Markings with Reflectorized Thermoplastic Paint	sq.m.	68052
504(2)	Road Markings with Reflectorized Thermoplastic Paint	sq.m.	16193
5.5	**Roadside Markers**		
505(1)	Kilometer Post	nr.	14
505(2)	Kilometer Post	nr.	180
5.6	**Road Lighting**		
506(1)	Pole Mounted Type Street Semi Cut-off Lamps 250W - Single Arm	nr.	338
SECTION 6 - SUBBASE AND BASE COURSE			
6.1	**Subbase Course**		
601(1)	Subbase Course (t=10cm)	cu.m.	27,402
6.2	**Aggregate Base Course**		
602(1)	Aggregate Road Base (t=25cm)	cu.m.	68,506
602(2)	Aggregate Road Base for Shoulder (t=18cm)	cu.m.	12,870
6.3	**Stabilized Base**		
603(1)	Asphalt Stabilization (t=8cm)	t	9,328
603(2)	Cement Stabilization (t=20cm)	t	27,402
6.4	**Leveling**		
604(1)	Leveling Pavement (t=3cm)	t	898
SECTION 7 - PAVEMENT			
7.1	**Prime Coat and Tack Coat**		
701(1)	Prime Coat	ltr.	203,291
701(2)	Tack Coat	itr.	231,143
7.2	**Asphaltic Concrete Surfacing**		
702(1)	Asphaltic Concrete Binder Course (t=6cm)	t	8,450
702(2)	Asphaltic Concrete Binder Course (t=8.5cm)	t	0
702(3)	Asphaltic Concrete Wearing Course (t=4cm)	t	6,252
702(4)	Asphaltic Concrete Wearing Course (t=5cm)	t	0
702(5)	Asphaltic Concrete Wearing Course for Bridge (t=2.5cm x 2 = 5cm)	t	0
7.3	**Waterproofing**		
703(1)	Waterproofing	ltr.	70,307
SECTION 8 - CONCRETE STRUCTURE FOR APPROACH ROAD SECTION			
8.1	**Substructure**		
801(1)	Substructure	ls	1
8.2	**Superstructure Work**		
802(1)	Superstructure Work	ls	1

Table 9.1.1 Bill of Quantities for the Project (cont'd)

SECTION 9 - CONCRETE STRUCTURE FOR LONG BRIDGE			
9.1	**Tower**		
901(1)	Framework for Tower	sq.m.	799.7
901(2)	Concrete Casting (G25) by Pumping Vehicle for Reinforce (incl. curing)	cu. m.	3246.5
901(3)	Rebar Working and Assembly	t	486.97
901(4)	Steel Pipe Driving	no	196
901(5)	Excavation of Inner Steel Pipe	no	98
901(6)	Concrete Casting for Inner Steel Pipe	m3	940.4
901(7)	Removal for Inner Steel Pipe Soil	m	0
901(8)	Mortal Insert in Joint	m	433
901(9)	Waterproofing Insert in Joint	m	0
901(10)	Excavation of Inner Casing	m3	0
901(11)	Sand Placing	m3	0
901(12)	Concrete Casting on Bottom of Pile	m3	0
9.2	**Anchorage**		
902(1)	Framework for Anchorage	sq.m.	16051.6
902(2)	Concrete Casting (G25) by Pumping Vehicle for Reinforce (incl. curing)	cu. m.	43580.6
902(3)	Rebar Working and Assembly	t	4059.552
902(4)	Prestressed Steel Bar	t	298.368
902(5)	Frame Support Against Tension	t	400
902(6)	Concrete Casting (G25) by Pumping Vehicle for Reinforce (incl. curing)	cu. m.	32081.8
902(7)	Rebar Working and Assembly	t	4812.27
902(8)	Steel Pipe Driving	no	602
902(9)	Excavation of Inner Steel Pipe	no	0
902(10)	Concrete Casting for Inner Steel Pipe	no	602
902(11)	Removal for Inner Steel Pipe Soil	m	0
902(12)	Mortal Insert in Joint	m	434.7
902(13)	Waterproofing Insert in Joint	m	0
902(14)	Excavation of Inner Casing	m3	0
902(15)	Sand Placing	m3	0
902(16)	Concrete Casting on Bottom of Pile	m3	0
902(17)	Removal Scaffolding and Sport in Casing	t	0
902(18)	Concrete Casting in Casing	m3	0
902(19)	Borrow Concrete Casting (G21) by Pumping Vehicle for Reinforce (incl. curing)	cu. m.	14750.9
902(20)	Lean Concrete Casting (G18) by Pumping Vehicle for Reinforce (incl. curing)	cu. m.	983.4
902(21)	Concrete Casting for Inner Steel Pipe Joint	m3	983.4
9.3	**Pier**		
903(1)	P1	ls	1
903(2)	P2	ls	1
903(3)	P3	ls	1
903(4)	P4	ls	1
903(5)	P5	ls	1
903(6)	P6	ls	1
903(7)	P7	ls	1
903(8)	P8	ls	1
903(9)	P9	ls	1
903(10)	P10	ls	1
903(11)	P11	ls	1
903(12)	P12	ls	1
903(13)	P13	ls	1
903(14)	P14	ls	1
903(15)	P15	ls	1
903(16)	P16	ls	1
903(17)	P17	ls	1
903(18)	P18	ls	1
903(19)	P19	ls	1
903(20)	P20	ls	1
903(21)	P21	ls	1
903(22)	P22	ls	1
903(23)	P23	ls	1
903(24)	P24	ls	1
903(25)	P25	ls	1
903(26)	P26	ls	1
903(27)	P27	ls	1
903(28)	P28	ls	1
903(29)	P29	ls	1
903(30)	P30	ls	1
903(31)	P31	ls	1
9.4	**Abutment**		
904(1)	AB1	ls	1
904(2)	AB2	ls	1

Table 9.1.1 Bill of Quantities for the Project (cont'd)

SECTION 10 - STEEL STRUCTURE			
10.1	**Fabrication of Steel Girders**		
1001(1)	Steel-I Girder Fabrication for V1	t	6681.761
10.2	**Trial Erection for Steel Girder**		
1002(1)	Trial Erection for V1	t	6681.761
10.3	**Erection of Steel Girders**		
1003(1)	Install and Removal of Bent Foundation for Steel-I Girder	set	360
1003(2)	Bent Facility installation and Removal for Steel-I Girder	set	360
1003(3)	Tentative Assembling Work for Steel-I Girder	ls	300
1003(4)	Erection Work for Steel-I Girder	ls	20
1003(5)	Permanente Bolt Work	nr.	400000
10.4	**Haul ring I Girder**		
1004(1)	Inland Transportation (V1)	ls	20
10.5	**Shoe (Bearing)**		
1005(1)	Elastomeric enclosed by steel plates type 3,500kN, Fix.	nr.	40
1005(2)	Elastomeric enclosed by steel plates type 2,000kN, Move.	nr.	64
1005(3)	Elastomeric enclosed by steel plates type 4,000kN, Fix.	nr.	48
10.6	**Expansion Joint**		
1006(1)	Elastomeric Type for 100mm Gap	m	187.6
10.7	**Deck Slab**		
1007(1)	Rebar Work	t	3848.376
1007(2)	Concrete Work (V=300~600m3/day)G35	cu.m.	2713
1007(3)	Concrete Work (V=300~600m3/day) G40	cu.m.	12828
10.8	**Bridge Surfacing**		
1008(1)	Asphaltic Concrete Binder Course (t=5cm)	t	32.5
SECTION 11 - MISCELLANEOUS ITEMS			
11.1	**Slope Protection**		
1101(1)	Left Bank	ls	1
1101(2)	Right Bank	ls	1
11.2	**Anchor**		
1102(1)	Concrete Block	ls	1
1102(2)	Anchor	ls	1
SECTION 12 - ELECTRICAL ROAD FACILITIES			
12.1	**Electrical Road Facilities**	ls	1
SECTION 13 - DIVERSION AND PROTECTION			
13.1	**Diversion and Protection**	ls	1
SECTION 14 - DAYWORK			
14.1	**Daywork**	ls	1
SECTION 15 - PROVISIONAL ITEMS			
15.1	**Provisional item**	ls	1
15.2	**Relocation of Existing Facilities**	ls	1

Source: JICA Survey Team

9.2 Conditions of Cost Estimate

9.2.1 Conditions

(1) Term of Cost Estimation

The unit prices of resources (labours, materials and equipment) adopted for this cost estimation are those prices at the time of May 2011, based on "PRICE FORMATION IN CONSTRUCTION" issued by INPROEKT No.4, April 2011.

(2) Exchange Rate

The exchange rates adopted for this cost estimate is as follows;

1 US Dollar (USD) = 7.97 Ukrainian Hryvnia (UAH).

1 US Dollar (USD) = 79.5 Japanese Yen (JPY).

I Ukrainian Hryvnia (UAH) =9.97 Japanese Yen (JPY)

(3) Taxes and Duties

1) Import Duty[1]

Average Tariff for agricultural products is 10.66%, and 4.95% for industrial products Regarding this projects, most of materials for the project will be industrial products, and therefore 5.0% tariff is proposed for cost estimation of this Project.

Ukraine has concluded free trade agreements with 11 countries; America, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Macedonia, Moldova, Russia, Turkmenistan, and Uzbekistan. Ukraine also has established favourable trade regimes with other 52 countries including Japan.

Since Ukraine jointed WTO, the negotiations on free trade area between EU and Ukraine were launched.

2) VAT[2]

VAT rate of Ukraine is 20 % until December 2013. The rate is to be reduced to 17% from January 2014.

(4) Price Escalation

Consumer Price Index (CPI) for Ukraine is summarized as shown in the table below. Inflation rate between year 2003 and 2010 was 170.2 %.(average escalation rate is 6.87%). Since current rate became stable, 1.6 % of escalation rate for local currency is applied for this project.

Table 9.2.1 Price Escalation Index

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ave
2003	101.50	102.60	103.70	104.50	104.50	104.60	104.50	102.70	103.30	104.70	106.60	108.20	**104.28**
2004	105.69	110.35	110.08	108.43	112.12	109.88	111.05	106.18	103.18	104.20	103.60	104.70	**107.46**
2005	101.70	102.70	104.40	105.10	105.70	106.40	106.70	106.70	107.10	108.10	109.40	110.40	**106.20**
2006	101.20	103.00	102.70	102.30	102.80	102.90	103.80	103.80	105.90	108.70	110.60	111.60	**104.94**
2007	100.50	101.10	101.30	101.30	101.90	104.20	105.60	106.20	108.60	111.70	114.20	116.60	**106.10**
2008	102.90	105.70	109.70	113.10	114.60	115.50	114.90	114.80	116.10	118.00	119.80	122.30	**113.95**
2009	102.90	104.40	105.90	106.90	107.40	108.60	108.50	108.20	109.10	110.10	111.30	112.30	**107.97**
2010	101.80	103.70	104.70	104.40	103.70	103.30	103.10	104.30	107.40	107.90			**104.43**

Infration Rate from Year 2003 to 2005	**114.64%**
Infration Rate from Year 2005 to 2010	**175.90%**

Escalation rate for foreign currency is to be 0.0% for this project.

(5) Physical Contingency

Physical contingencies for both foreign and local currencies are 5.0% of total construction cost.

(6) Base Year for Cost Escalation

Base year is August 2011, and construction work will start form April 2015 and end May 2019.

(7) Rate of Administration Cost

5.0% of direct construction cost will be the administration cost.

(8) Rate of Interest During Construction

1.4% for the construction work and 0.01% for the consultant work will be applied.

[1] Arab Gateway to Ukraine (Web site)
[2] Tax Newsletter; January 11, 2011 (PWC)

(9) Rate of Commitment Charges

Rate of commitment charges will be 0.1%.

9.2.2 Unit Cost for Preliminary Design Stage

The Unit cost for the preliminary design stage will be determined by referring to unit costs of past bridge construction projects in Ukraine, as well as considering the price escalation rates and the document mentioned above. Unit costs applied for this survey are follows.

Table 9.2.2 Unit Costs of Labours

ID	ITEM	STANDARED	UNIT	RATE(UAH)
LA-001	Skilled Labour A		day	
LA-002	Skilled Labour B		day	
LA-003	Semi Skilled Labour		day	
LA-004	Unskilled Labour		day	
LA-005	Foreman/Ganger		day	
LA-006	Rebar Worker		day	
LA-007	Concrete Worker		day	
LA-008	Scaffolder	Rigger	day	
LA-009	Bricklayer		day	
LA-010	Mason		day	
LA-011	Carpenter		day	
LA-012	Electrician		day	
LA-013	Mechanic		day	
LA-014	Welder		day	
LA-015	Machine Operator		day	
LA-016	Assistant Operator		day	
LA-017	Driver		day	
LA-018	Bridge Foreman		day	
LA-019	Bridge Skilled Labour		day	
LA-020	Bridge Unskilled Labour		day	
LA-021	Engineer A	20 years	mth	
LA-022	Engineer B	10 years	mth	
LA-023	Engineer C	5 years	mth	
LA-024	Survey Assistant		mth	
LA-025	Labourer		mth	
LA-031	Administrator		mth	
LA-032	Draftsman		mth	
LA-033	Typist		mth	
LA-034	Driver		mth	
LA-035	Office boy		mth	
LA-036	Guard man		mth	
LA-037	House Keeper		mth	
LA-051	Electrician (Special Grade)		day	
LA-052	Senior Surveyor		mth	
LA-053	Junior Surveyor		mth	
LA-054	Bridge Carpenter		day	

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Table 9.2.3 Unit Costs of Materials

ID	ITEM	STANDARED	UNIT	RATE (UHA)
LA-033	Typist		mth	
LA-034	Driver		mth	
LA-035	Office boy		mth	
LA-036	Guard man		mth	
LA-037	House Keeper		mth	
LA-051	Electrician (Special Grade)		day	
LA-052	Senior Surveyor		mth	
LA-053	Junior Surveyor		mth	
LA-054	Bridge Carpenter		day	
MT-001	Cement (OPC)		t	
MT-002	High Yield Steel Bars	D13 - D25, Grade 460	t	
MT-003	High Yield Steel Bars	D29 -, Grade 460	t	
MT-004	Mild Steel Bars	D13 - D25, Grade 350	t	
MT-005	Mild Steel Bars	D29 -, Grade 350	t	
MT-007	Resdy Mixed Concrete	Grade 50(20)	cu.m.	
MT-009	Ready Mixed Concrete	Grade 40(20)	cu.m.	
MT-010	Ready Mixed Concrete	Grade 35(20)	cu.m.	
MT-011	Ready Mixed Concrete	Grade 30(20)	cu.m.	
MT-012	Ready Mixed Concrete	Grade 25(20)	cu.m.	
MT-013	Ready Mixed Concrete	Grade 20(20)	cu.m.	
MT-014	Ready Mixed Concrete	Grade 15(20)	cu.m.	
MT-300	Rubble (for Soft Soil Replace)	max. 300mm	cu.m.	
MT-301	Rubble	150mm-225mm	cu.m.	
MT-302	Rubble	150mm-225mm	cu.m.	
MT-307	Aggregate	100mm	cu.m.	
MT-308	Aggregate	19mm	cu.m.	
MT-309	Aggregate	12.5mm	cu.m.	
MT-310	Aggregate	37.5mm	cu.m.	
MT-311	Aggregate	50mm	cu.m.	
MT-312	Crusher Fines	6.3mm.Down Wards	cu.m.	
MT-313	Graded	37.5mm (ABLE 1701.5 for ABC)	cu.m.	
MT-314	Aggregate	19mm for Seal Coat	cu.m.	
MT-315	Aggregate	12.5mm for Seal Coat	cu.m.	
MT-316	Aggregate	9.5mm for Seal Coat	cu.m.	
MT-331	River Sand for Road Surface	SSCM Table 1701-9	cu.m.	
MT-332	River Sand for Concrete and Masonry	SSCM Table 1701-2	cu.m.	
MT-340	Building Bricks	Burnt Cray (SLS 39:1978)	1000n	
MT-351	Bitumen	80/100 (Ex-Stock)	ltr.	
MT-352	Emulsion-C.S.S.1		ltr.	
MT-353	Emulsion-C.R.S.1	(Exclu. Transport)	ltr.	
MT-354	Emulsion-C.R.S.2	(Exclu. Transport)	ltr.	
MT-355	Bitumen	80/100(Bulk, at Site)	kg	
MT-356	Bitumen	60/70 (Ex-Stock)	ltr.	
MT-361	Asphalt Concrete Surfacing Material	Binder 60/70	m.t.	
MT-362	Asphalt Concrete Bound Base Material	Binder 60/70	m.t.	
MI-003	Steel Plate	9mm Thick	t	
MI-015	H- Section Steel	H-300×300×10×15	t	
MI-016	H- Section Steel	H-350×350×13×21	t	
MI-017	C- Section Steel	C-380×100×13×20	t	
MI-020	Equal Leg Angle	L. 6×50×50mm	t	
MI-021	Equal Leg Angle	L120×120×12	t	
MI-023	Steel Pipe		t	
MI-141	Borrow pit soil		cu.m.	

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Table 9.2.4 Unit Costs of Main Equipment

ID NO	Plant & Equipment	Capacity	Unit	Adoption		
				Foreign Yen	**Local** UAH	**Combined** UAH
EQ-01d	Bulldozer - D8	32t	day			
EQ-02d	Bulldozer - D6	21t	day			
EQ-05d	Motor Grader	3.7m	day			
EQ-06d	Wheel Loader	1.5-1.7m^3	day			
EQ-07d	Wheel Loader	2.5-2.9m^3	day			
EQ-08d	Backhoe	1.4m^3	day			
EQ-09d	Backhoe	0.8m^3	day			
EQ-10d	Dump Truck	10t	day			
EQ-11d	Dump Truck	20t	day			
EQ-12d	Agitator Truck	4.4-4.5m^3	day			
EQ-13d	Concrete Pump	100m^3/hr.	day			
EQ-14d	Vibration Roller	2.4-2.8t	day			
EQ-15d	Macadam Roller	10-12t	day			
EQ-16d	Tire Roller	8-20t	day			
EQ-17d	Tamping Roller	13.5-20.7t	day			
EQ-18d	Asphalt Sprayer	1000-1500 l	day			
EQ-19d	Asphalt Paver	2.4-6m	day			
EQ-20d	Crawler Crane	50t	day			
EQ-21d	Crawler Crane	100t	day			
EQ-22d	Track Crane	25t	day			
EQ-23d	Track Crane	50t	day			
EQ-24d	Track Crane	120t	day			
EQ-25d	Diesel Hammer	4.5t	day			
EQ-26d	Vibro-Hammer	60kw	day			
EQ-27d	Water Jet for piling	325 l/min	day			
EQ-28d	Generator	100Kva	day			
EQ-29d	Generator	200Kva	day			
EQ-30d	Generator	300Kva	day			
EQ-31d	Air Compressor	7.5-7.8m^3	day			
EQ-32d	Concrete Breaker	40kg.	day			
EQ-33d	Rammer	60-100kg.	day			
EQ-35d	Cargo Truck 10 t w/Crane 2.9t	329Ps	day			
EQ-36d	Lane Marker hand guide type 15cm	80-120kg	day			
EQ-37d	Asphalt Plant	120t/h	day			
EQ-38d	Asphalt Plant	180t/h	day			
EQ-39d	Concrete Batching plant	45m3/hr	day			
EQ-40d	Concrete Batching plant	60m3/hr	day			
EQ-41d	Crane with Dredge bucket	60m3/hr	day			
EQ-44d	Crawler drill (Air type)	80kg	day			
EQ-45d	Crawler drill (Hydraulic Type)	100kg	day			
EQ-46d	Breaker (Air)	100kg	day			
EQ-47d	Crushing Plant	500x750	day			
EQ-133d	Track Crane	160t	day			
EQ-134d	Track Crane	200t	day			
EQ-135d	Pickup Car	Double, 2WD	day			
EQ-136d	All Casing Drill		day			

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9.3 Cost Estimate for Preliminary Design

9.3.1 Results of Cost Estimation

Results of cost estimation are shown in Table 9.3.1 and the followings.

(1) Construction Cost (BQ section A1: 1 to 15)

Construction cost (without tax and contingencies) is estimated approximately ***** UAH (equivalent to ***** USD) including Main Bridge (***** UAH), Approach Bridge (***** UAH) and Approach Road and others (***** UAH).

(2) Engineering Service Cost without Tax and Contingency (BQ section B1)

Engineering service cost (without tax and contingencies) is estimated approximately ***** UAH (equivalent to ***** USD)

(3) Construction and Engineering Service Cost with Contingencies (Price Escalation and Physical Contingency) (BQ section A1+A2+A3+B1+B2+B3)

Construction cost including contingencies is estimated approximately ***** UAH (equivalent to ***** USD). Within the total amount, foreign currency portion is *** %, whereas local currency portion is *** %.

(4) Construction and Engineering Service Cost with Contingencies and Administration Cost (BQ section A1+ A2+A3+ B1+B2+B3+D)

Construction cost including contingencies and administration cost is estimated approximately ***** UAH (equivalent to ***** USD).

(5) Total Project Cost (BQ section A1+A2+A3+B1+B2+B3+C1+C2+D+E+F+G)

Total project cost including engineering services and compensation (land acquisition and others) is estimated approximately ***** UAH (equivalent to ***** USD).

Table 9.3.1 Results of Cost Estimation

		Work Item	Foreign (JPY)	Local (UAH)	Total Amount (UAH)	Total Amount (1000 JPY)	Remarks
A1	Construction Cost						
1		Preliminaries & General					
	1.1	Preliminaries & General					
		Total 1					
2		Site Clearing					
	2.1	Site Clearing					
		Total 2					
3		Earth Works					
	3.1	Excavation					
	3.2	Embankment					
	3.3	Slope Protection					
		Total 3					
4		Drainage					
	4.1	Pipe Culvert					
	4.2	Ditches					
	4.3	Catch Basin					
	4.4	Underground Ditch					
		Total 4					
5		Incidentals					
	5.1	Greenery Works					
	5.2	Road Furniture					
		Total 5					
6		Subbase and Base Course					
	6.1	Subbase Course					
	6.2	Aggregate Road Base					
	6.3	Stabilized Base					
	6.4	Leveling					
		Total 6					
7		Pavement					
	7.1	Prime Coat and Tack Coat					
	7.2	Asphaltic Concrete Surfacing					
	7.3	Waterproofing					
		Total 7					
8		Concrete Structure for Approach Road Section					
	8.1	Substructure					
	8.2	Superstructure Work					
		Total 8					
9		Concrete Structure for Long Bridge					
	9.1	Tower					
	9.2	Anchorage					
	9.3	Pier					
	9.4	Abutment					
		Total 9					
10		Steel Structure					
	10.1	Fabrication of Steel Girders					
	10.2	Traial Erection for Sttel Girder					
	10.3	Erection of Steel Girders					
	10.4	Haulaging I Girder					
	10.5	Shoe (Bearing)					
	10.6	Expansion Joint					
	10.7	Deck Slab					
	10.8	Bridge Surfacing					
	10.9	Suspension Bridge					
		Total 10					
11		Miscellaneous Items					
	11.1	Slope Protection					
		Total 11					
12		Electrical Road Facilities					
	12.1	Electrical Road Facilities					
		Total 12					
13		Diversion and Protection					
	13.1	Diversion and Protection					
		Total 13					
14		Daywork					
	14.1	Daywork					
		Total 14					
15		Provisional Sums					
	15.1	Provisional item					
	15.2	Relocation of Existing Facilities					
		Total 15					
		Construction Cost (Total A1)					

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Table 9.3.1 Results of Cost Estimation (cont'd)

A2	Price Escalation						
		Total A2					
A3	Physical Contingency						5% of (A1+A2)
		Total A3					
		Construction Cost (A1+A2+A3)					
B	Engineering Services						
	B1	Engineering Cost					
	B2	Price Escalation					
	B3	Physical Contingency					5% of (B1+B2)
		Total B					
		Total (A+B)					
C	Land Acquisition & Others						
	C1	Land Acquisition					
	C2	Compensation for Buildings					
	C3	Price Escalation					
	C4	Physical Contingency					
		Total C					
D	Administration Cost of SRA						5% of (B+C)
		Total D					
E	Tax						
	E1	VAT					20% of (A+B)
	E2	Import Tax					5% of (A+B)
		Total of E					
F	Interest						1.4%/Year of Construction Cost
	F1	Construction					1.4%
	F2	Consultant					0.01%
		Total F					
G	Commitment Charge						0.1%/Year
		TOTAL PROJECT COST					

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9.3.2 Cost Breakdown for Each Section

The results of cost breakdown for each section (main bridge, approach bridge and approach road) are shown in Table 9.3.2.

Table 9.3.2 Cost Breakdown for Each Section

Item	Local	Total
	UAH	JPY
Land Acquisition Cost	Confidential	

Main Bridge Section

Item	Cost		Total
	Foreign	Local	
	JPY	UAH	JPY
Preparation			
Substructure			
Superstructure Approach			
Superstructure Bridge			
Other			
Total			

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Approach Bridge Section

Item	Cost		Total
	Foreign	Local	
	JPY	UAH	JPY
Preparation			
Substructure			
Superstructure			
Other			
Total			

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Access Road Section

Item	Cost		Total
	Foreign	Local	
	JPY	UAH	JPY
Preparation			
Road			
Other			
Total			

Confidential

CHAPTER 10

CONSIDERATIONS TO APPLY JAPANESE ODA LOAN

10. CONSIDERATION TO APPLY JAPANESE ODA LOAN

10.1 Risk Analysis for the Project

There will be following risks for implementing Mykolaiv Bridge Project.

Table 10.1.1 Risks for Mykolaiv Bridge Project

Nature of Risk	Description	Response
Country Risk	Around 30 % of the people in Ukraine are Russian and the Mykolaiv Bridge is located in The Russian resident area. Political turmoil has been terminated since the President election of 2010, however still remaining some political uncertainty between pro-Russia and pro US party, and it may affect on implementation of the Project.	Updating political and economical information of the country is required to avoid the effect of those risks.
Economic Fluctuation Risk	Ukraine has experienced furious inflation of 170.2% in past 7 years (from 2003 to 2010). Ukrainian economy has been substantially affected by the policy of Russian government because, in Ukraine, the large parts of energy has been imported from Russia.	Updating political and economical information of the country is required to avoid the effect of those risks.
Foreign Exchange Risk	The Ukrainian currency is relatively steady against Euro and US dollar in these days, however, Ukrainian economic situation is still week because of economic recession in recent years.	Updating political and economical information of the country is required to avoid the effect of those risks.
Market Risk	The price escalation of steel may have huge impact on the cost of suspension bridge.	5 % of price escalation is considered for cost estimation of this project.
Project Management Risk	Ukravtodor and designated local consultants may not have ability to complete feasibility study for the suspension bridge, and consequently, the cabinet approval for the Project may delay. Mutual miscomprehensions on project approve and appraisal schedule may cause delay of the Project.	The consultants who made preliminary design shall assist Ukravtodor and the local consultants. Close communication between two sides at design stage is required to avoid those miscomprehension.
Demand Forecasting Risk	Actual traffic volume in future may be less than the number of forecasted volume. The benefit from project will Delay of the development of Ochakov Port may cause shrinkage of heavy vehicle traffic volume.	Sensitive analysis was done in this report (chapter 11) to grasp the effect of the risk.

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In Ukraine, "Political Risk" was the most critical issue for donor in 1990s. The World Bank has a guideline[1] to assess and minimize these political risks for lending operations in Ukraine. The guideline recommends taking some actions to mitigate the political risks throughout whole stages of the project, i.e., project identification stage, project preparation stage, project appraisal stage, post-appraisal stage and project implementation and supervision stage.

10.2 Safety Countermeasures for the Project

(1) Construction during winter

During construction stage, outside work in winter is sometimes dangerous, especially on the river. Ukrainian labour law restricts outside work in heavy snow. The work on the river is also restricted in frozen period.

To ensure the safety of workers, 3 months halts in winter was considered in implementation of the Mykolaiv Bridge Project.

(2) Proposal for procurement of bridge engineer and skilled labour needed to suspension bridge construction

The suspension bridge construction requires special machinery and equipment in order to carry out stiffening girder construction work and operation of the cable work. Handling those machinery and equipment is sometimes dangerous for the general workers.

Because lack of experience of these special works for local contractor, it is recommended to procure skilled labours and bridge engineer for the suspension bridge internationally.

(3) Temporary structure construction plan check system

The temporary structures of the bridge work include the following.

- Temporary stage surrounding the piers
- Temporary tower cranes and other facilities for Pylon work
- Temporary cable cranes and other facilities for cable erection and stiffening girder work

Temporary structures require "quality assurance" in order to secure safety work during the construction stage. Establishment of the Check system for temporary work is also essential to assure the safety work. Usually, the consultants will act as the checker for these temporary works on behalf of the Client.

Just as mentioned above, the suspension bridge construction also requires special temporary works in order to carry out stiffening girder construction work and operation of the cable work. Therefore it is recommended to procure international experienced consultants for the Mykolaiv Bridge Project.

[1] "A Strategy and Guidelines for the Assessment and Minimization of Political Risk with Examples from World Bank Lending in Ukraine" Susan Mueller Consultants Country Director's Office, ECC11, March 2002

10.3 Technical Assistance and Transfer

Technical Assistance and Transfer of the suspension bridge to Ukrainian side will be necessary for feasibility study phase, basic design phase, construction phase and operation and maintenance phase as shown in Table 10.3.1.

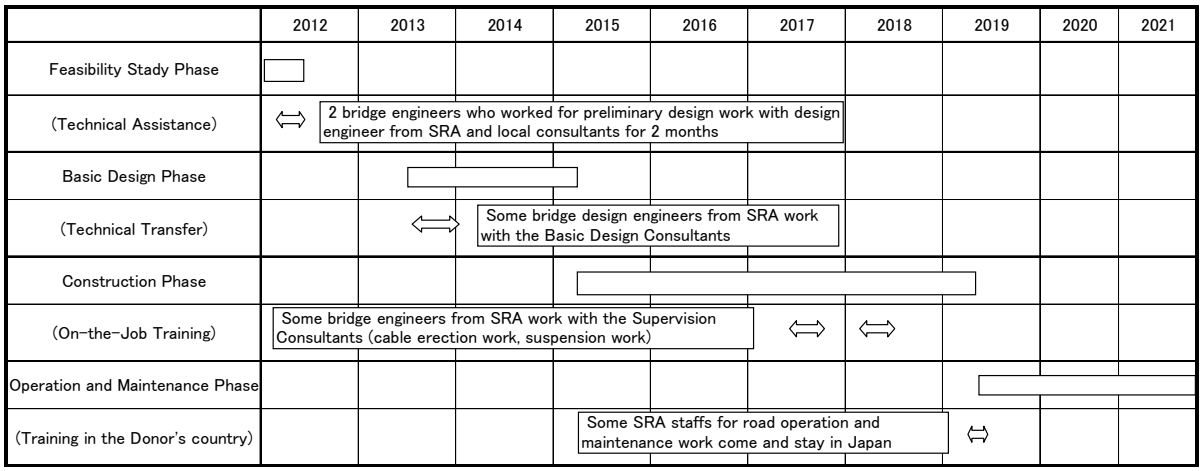
These technical assistance and transfer will be useful for Ukrainian side in order to applying the long span bridge, in near future, for new or reconstruction bridges on main rivers of Ukraine such as Dnieper River.

Table 10.3.1 Technical Assistance and Transfer Plan

Phase	Counterpart	Contents	Duration	Assisting Agency
Feasibility Study Phase	SRA (assisting local consultants)	• To provide the result of preliminary design (calculation and drawings) • To collaborate for feasibility study of suspension bridge	2 month	・Consultants of Preliminary Design Phase
Basic Design Phase	SRA (Bridge design engineers)	• To collaborate for basic design of suspension bridge	3 month	・Consultants performing Basic Design
Construction Phase	SRA (Bridge engineers)	• Construction supervision for Suspension bridge (on-the-job training)	6 month	・Consultants performing Construction Supervision
Operation and Maintenance Phase	SRA (Operation and Maintenance Staff)	• Training in the assisting country	2 weeks	・JICA

Technical Assistance and Transfer Schedule is shown in Table 10.3.2

Table 10.3.2 Technical Assistance and Transfer Schedule



CHAPTER 11

PROJECT EVALUATION AND CONCLUSION

11. PROJECT EVALUATION AND CONCLUSIONS

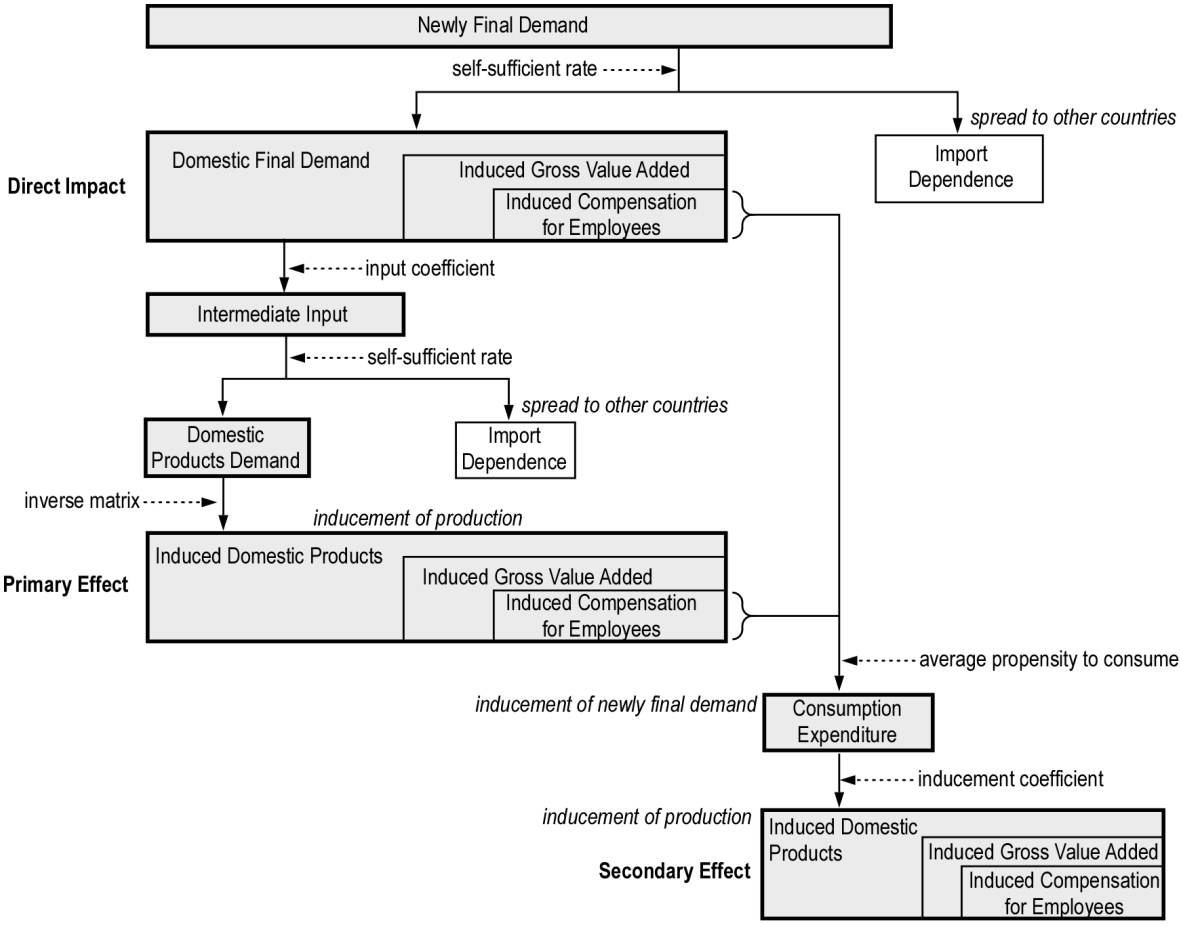
11.1 Effects of the Project

In general, infrastructure development is expected to produce two types of benefits, namely, i) flow effect (or demand creation effect) by the revitalization of activity of relevant industries by the investment in infrastructure development, and ii) stock effect by the services provided by the developed infrastructure for a long term such as improvement of productivity, safety and the environment. As the effects by the construction of New Mykolaiv Bridge, the following two effects were measured.

- Flow effect: i) By using an Input-Output Table of the Ukraine, ripple effects on the economy of Ukraine by the construction of the New Mykolaiv Bridge were estimated, and ii) increase of trade between Ukraine and Japan caused by increase of Ukraine's GDP by the ripple effects were estimated.
- Stock effect: i) New Mykolaiv Bridge and completion of the M14 Bypass is expected to alleviate future traffic congestion in the Mykolaiv Region. Based on the future traffic volume forecasting, improvement of vehicular travel speed and reduction of green-house gases were estimated. ii) The New Mykolaiv Bridge is expected to reduce distance travelled by vehicular traffic, especially heavy vehicles, through the M14 Bypass. Based on the distance related operating cost of vehicles and the reduction of distance travelled, transport cost savings of cargo transported from/to Japan were estimated.

11.1.1 Flow Effect of the Project

Figure 11.1.1 shows the typical flow for measuring the ripple effect. The ripple effect consists of three parts, namely, i) direct impact, ii) primary effect and iii) secondary effect. Direct impact is additional domestic product created to satisfy the new demand or consumption such as construction of the bridge. For the construction of the bridge, various materials are required such as articles of concrete, steel and other materials. The primary effect is the induced domestic products to produce such required materials for the construction of the bridge. For the construction of the bridge and production of construction materials, employees work and obtain wages. Employees spend some portion of their wages to purchase food, clothes and other commodities and services. The secondary effect is the induced domestic products to the produce food, clothes and other commodities consumed by the employees.



Source: JICA Survey Team

Figure 11.1.1 Flow and Image of Ripple Effect

(1) I-O Table

I-O Table for 2010 shown in Table 11.1.2 is estimated by the I-O Table for 2009 and GDP deflators for 2010 prepared by the State Statistics Committee in Ukraine as shown in Table 11.1.1.

Table 11.1.1 The Changes of Gross Domestic Product Deflator for 2010

Items	%
Gross domestic product	**15.0**
Composition of gross domestic product	
1. Production side	
Agriculture, hunting, forestry	21.7
Mining and quarrying	51.9
Manufacturing	2.9
Electricity, gas and water supply	3.7
Construction	53.4
Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods	12.9
Transport, storage and communication	20.0
Education	16.4
Health care and social work	21.3
Other types of economic activity	12.4
with them	
financial activities	3.7
real estate, renting and business activities	18.1
public administration	11.8
Financial intermediation services indirectly measured	1.0
Taxes on products	6.9
Subsidies on products	21.5
2. Expenditure side	
2.1. Final consumption expenditure	11.6
in particular:	
of households	10.1
of non-profit institutions serving households	9.6
of general government	16.5
in particular:	
individual consumption expenditure	17.3
collective consumption expenditure	14.8
2.2. Gross capital formation	18.9
in particular:	
gross fixed capital formation	18.5
changes in inventories	x
acquisitions less disposals of valuables	9.8
2.3 Exports of goods and services	24.1
2.4 Imports of goods and services	18.9

Note: per cent over the previous year, at the 2007 constant prices

Source: State Statistics Committee of Ukraine

Table 11.1.2 Estimated Input-Output Table of Ukraine in 2010

(mln.UAH)

	Intermediate consumption																
	Agriculture, hunting, forestr	Fishing, fishery	Mining	Manufacturing	Production and distribution electricity, gas and water	Construction	Trade; repair of motor vehicl household appliances and personal demand items	Activity of hotels and restaurants	Activity of transport and communications	Financial activity	Real estate activities, rentin engineering and provision services to businessmen	Public administration	Education	Health care and provision o social aid	Provision of communal and individual services; cultural and sporting activity	Financial intermediation services indirectly measured	Total
Agriculture, hunting, forestry	58,410	155	259	37,538	19	67	1,704	701	55	0	303	952	3,311	1,376	107		**104,958**
Fishing, fishery	38	148	1	553	1	1	9	218	1	0	0	50	166	75	2		**1,263**
Mining	2,866	9	9,728	168,178	47,242	5,256	1,182	135	16,563	17	2,383	849	2,850	1,220	263		**258,740**
Manufacturing	34,792	304	16,295	284,816	10,974	43,230	17,837	6,466	35,670	1,736	21,124	5,189	5,949	12,115	3,283		**499,780**
Production and distribution of electricity, gas and water	2,258	50	8,285	26,542	6,906	1,000	2,702	565	8,034	79	6,480	1,860	5,861	2,872	1,028		**74,522**
Construction	54	0	163	351	252	808	141	41	428	9	4,992	584	170	164	156		**8,314**
Trade; repair of motor vehicles, household appliances and personal demand items	26,140	395	7,772	217,261	145	978	8,398	238	1,857	724	1,503	148	91	154	327		**266,130**
Activity of hotels and restaurants	52	2	218	1,220	268	496	1,791	99	1,064	183	1,299	842	226	88	523		**8,361**
Activity of transport and communications	9,504	175	15,442	55,649	1,246	4,399	26,220	317	23,011	979	5,828	2,261	906	794	1,439		**148,170**
Financial activity	438	7	772	7,805	1,529	693	8,285	211	1,268	15,691	8,059	500	428	377	504	61,883	**108,449**
Real estate activities, renting, engineering and provision of services to businessmen	1,900	25	1,448	16,236	1,704	3,519	51,844	1,753	8,683	6,731	33,116	1,288	1,254	1,088	2,481		**133,070**
Public administration	67	2	230	2,522	756	332	1,837	78	913	163	1,022	367	1,343	159	366		**10,157**
Education	13	0	49	125	56	26	378	12	128	30	336	122	452	55	98		**1,879**
Health care and provision of social aid	72	5	161	505	106	82	363	29	575	55	364	274	183	190	137		**3,100**
Provision of communal and individual services; cultural and sporting activity	37	1	169	873	233	88	2,344	325	544	37	3,205	830	1,054	419	7,944		**18,102**
Intermediate consumption	**136,639**	**1,278**	**60,991**	**820,175**	**71,436**	**60,975**	**125,832**	**11,188**	**98,794**	**26,433**	**90,006**	**16,117**	**24,244**	**21,148**	**18,658**	**61,883**	**1,644,996**
Compensation of employees	15,812	202	30,104	91,121	24,140	16,164	52,005	4,265	54,359	26,139	44,053	49,306	49,712	32,303	14,915		**504,601**
Other taxes less subsidies on production	-285	6	-5,874	633	-1,972	471	3,758	219	1,319	1,002	457	43	82	98	-1,737		**-1,779**
Taxes less subsidies on products	2,491	281	6,563	92,175	8,566	4,019	1,394	1,859	9,332	951	2,986	19	2,042	974	1,558		**135,212**
Gross operating surplus, mixed income	55,180	81	20,031	63,656	12,679	7,089	85,368	4,304	50,314	45,192	59,359	2,954	5,004	5,952	5,803	-61,883	**361,083**
Gross domestic product (at market prices)	**73,198**	**570**	**50,824**	**247,585**	**43,413**	**27,744**	**142,525**	**10,647**	**115,325**	**73,284**	**106,855**	**52,321**	**56,840**	**39,326**	**20,540**	**-61,883**	**999,117**
Output of goods and services	**209,837**	**1,849**	**111,814**	**1,067,760**	**114,849**	**88,719**	**267,357**	**21,835**	**214,120**	**99,717**	**196,861**	**68,438**	**81,084**	**60,476**	**39,198**		**2,644,113**
Info																	
Output of goods and services (at basic prices)	157,867	926	78,492	628,232	85,749	77,631	239,327	18,392	182,914	91,199	174,934	61,246	70,706	54,100	33,971		**1,955,685**
Trade and transport margin																	**261,701**

	Final consumption expenditure			Gross capital formation			Exports	Imports	Use of production
	Of households	Of non-profit institutions serving households	Of general government	Gross fixed capital formation	Changes in inventories	Net acquisitions of valuables			
Agriculture, hunting, forestry	81,752	0	1,669	1,227	-578	0	52,786	-15,669	**226,045**
Fishing, fishery	3,528	0	0	0	199	0	247	-3,816	**1,421**
Mining	13,116	0	1,457	0	-1,259	0	21,939	-136,484	**157,510**
Manufacturing	419,671	0	1,286	91,405	-9,171	579	348,773	-343,492	**1,008,831**
Production and distribution of electricity, gas and water	19,634	0	2,824	0	0	0	2,758	-85	**99,653**
Construction	1,784	0	0	91,376	-1,829	0	2,383	-841	**101,189**
Trade; repair of motor vehicles, household appliances and personal demand items	5,705	0	16	0	0	0	790	-897	**271,745**
Activity of hotels and restaurants	13,292	0	280	0	0	0	11,823	-11,204	**22,553**
Activity of transport and communications	44,463	0	6,173	0	0	0	75,602	-47,856	**226,552**
Financial activity	5,038	0	0	0	0	0	4,493	-15,812	**102,168**
Real estate activities, renting, engineering and provision of services to businessmen	47,529	1,525	8,324	21,021	205	0	16,421	-20,025	**208,071**
Public administration	573	0	58,265	0	0	0	206	-2,108	**67,094**
Education	12,045	633	65,808	0	0	0	261	-67	**80,558**
Health care and provision of social aid	8,202	1,357	48,291	0	0	0	659	-375	**61,235**
Provision of communal and individual services; cultural and sporting activity	10,693	4,371	7,654	0	0	11	3,020	-4,264	**39,587**
Intermediate consumption	**667,027**	**7,886**	**202,047**	**205,029**	**-12,532**	**589**	**542,162**	**-602,994**	**2,674,211**

Source: JICA Survey Team

For the estimation of project impact, a Leontief Inverse Matrix as shown in Table 11.1.3 is calculated based on the I-O Table for 2010.

$$\text{Leontief Inverse Matrix} = \left[I - \left(I - \hat{M}\right)A\right]^{-1}$$

where,

I : Identity Matrix,

$\hat{M}$: Import Coefficient Matrix, and

A : Input Coefficient Matrix

Table 11.1.3 Leontief Inverse Matrix of Ukraine for 2010

	Agriculture, hunting, forestry	Fishing, fishery	Mining	Manufacturing	Production and distribution of electricity, gas and water	Construction	Trade; repair of motor vehicles, household appliances and personal demand items	Activity of hotels and restaurants	Activity of transport and communications	Financial activity	Real estate activities, renting, engineering and provision of services to businessmen	Public administration	Education	Health care and provision of social aid	Provision of communal and individual services; cultural and sporting activity
Agriculture, hunting, forestry	1.35445	0.11650	0.01179	0.05849	0.00731	0.02143	0.01390	0.05316	0.00908	0.00178	0.00927	0.02189	0.05555	0.03715	0.01059
Fishing, fishery	0.00009	1.01931	0.00003	0.00017	0.00003	0.00007	0.00004	0.00244	0.00004	0.00001	0.00003	0.00021	0.00052	0.00033	0.00006
Mining	0.03911	0.03700	1.08719	0.12243	0.24701	0.07934	0.02324	0.03910	0.07251	0.00527	0.03322	0.02408	0.04667	0.04160	0.02708
Manufacturing	0.21773	0.19848	0.16855	1.27826	0.12862	0.43435	0.10297	0.27649	0.17443	0.02978	0.13677	0.08616	0.09075	0.18819	0.11479
Production and distribution of electricity, gas and water	0.03298	0.05041	0.09962	0.05486	1.09130	0.03801	0.02946	0.04619	0.05842	0.00640	0.05239	0.03759	0.08768	0.06306	0.04667
Construction	0.00265	0.00295	0.00360	0.00346	0.00397	1.01183	0.00694	0.00533	0.00432	0.00247	0.03099	0.00976	0.00350	0.00413	0.00788
Trade; repair of motor vehicles, household appliances and personal demand items	0.22356	0.28566	0.11663	0.28587	0.04797	0.11251	1.06068	0.08102	0.05366	0.01643	0.04314	0.02591	0.03165	0.05074	0.03958
Activity of hotels and restaurants	0.00160	0.00245	0.00224	0.00248	0.00207	0.00406	0.00480	1.00342	0.00343	0.00149	0.00462	0.00661	0.00207	0.00142	0.00886
Activity of transport and communications	0.08518	0.12346	0.14407	0.09788	0.04935	0.08206	0.10095	0.04155	1.11219	0.01522	0.04611	0.03911	0.02601	0.03148	0.05272
Financial activity	0.01545	0.01987	0.01676	0.02424	0.02058	0.01953	0.04445	0.02039	0.01368	1.16130	0.05316	0.01138	0.01033	0.01231	0.02321
Real estate activities, renting, engineering and provision of services to businessmen	0.06942	0.08710	0.05188	0.09000	0.03728	0.08093	0.23168	0.11412	0.06616	0.08893	1.20151	0.03275	0.03091	0.03806	0.09954
Public administration	0.00351	0.00509	0.00497	0.00647	0.00362	0.00671	0.00945	0.00608	0.00636	0.00264	0.00774	1.00647	0.01778	0.00431	0.01290
Education	0.00065	0.00074	0.00092	0.00089	0.00086	0.00078	0.00208	0.00102	0.00097	0.00056	0.00231	0.00201	1.00587	0.00118	0.00342
Health care and provision of social aid	0.00135	0.00384	0.00243	0.00173	0.00175	0.00188	0.00238	0.00213	0.00348	0.00091	0.00274	0.00442	0.00278	1.00365	0.00488
Provision of communal and individual services; cultural and sporting activity	0.00431	0.00584	0.00475	0.00626	0.00439	0.00464	0.01505	0.01981	0.00538	0.00238	0.02252	0.01468	0.01590	0.00936	1.22473

Source: JICA Survey Team

(2) Direct Impact and Primary Effect

Induced domestic products consist of direct impacts and primary effect is calculated by the following formula.

$$\text{Induced Domestic Products} = \left[I - \left(I - \hat{M}\right)A\right]^{-1} \times \left[\left(I - \hat{M}\right) \times Fc\right]$$

where,

$\left[I - \left(I - \hat{M}\right)A\right]^{-1}$: Leontief Inverse Matrix,

I : Identity Matrix,

$\hat{M}$: Import Coefficient Matrix,

A : Input Coefficient Matrix, and

Fc : Final Consumption (construction cost of the project).

The construction of the new Mykolaiv Bridge is expected to induce 7.19 billion UAH of domestic products in Ukraine as shown in Table 11.1.4. This amount is about 0.66% of GDP in 2010 which was 1,083.2 billion UAH.

Table 11.1.4 Induced Domestic Products by Construction of the New Mykolaiv Bridge

Sector	million UAH
Agriculture, hunting, forestry	81.2
Fishing, fishery	0.3
Mining	300.6
Manufacturing	1,645.9
Production and distribution of electricity, gas and water	144.0
Construction	3,834.1
Trade; repair of motor vehicles, household appliances and personal demand items	426.3
Activity of hotels and restaurants	15.4
Activity of transport and communications	310.9
Financial activity	74.0
Real estate activities, renting, engineering and provision of services to businessmen	306.6
Public administration	25.4
Education	3.0
Health care and provision of social aid	7.1
Provision of communal and individual services; cultural and sporting activity	17.6
Total	7,192.4

Source: JICA Survey Team

(3) Secondary Effects

Secondary effects of the project are the induced domestic products due to the increase of employee's income and expenditures. They are calculated by compensation of employees and GDP by sector as shown in the following table. Total induced compensation of employees is about 1.24 billion UAH.

Table 11.1.5 Induced Compensation of Employees

Sector	Induced compensation of employees (million UAH)
Agriculture, hunting, forestry	6.1
Fishing, fishery	0.0
Mining	80.9
Manufacturing	140.5
Production and distribution of electricity, gas and water	30.3
Construction	698.5
Trade; repair of motor vehicles, household appliances and personal demand items	82.9
Activity of hotels and restaurants	3.0
Activity of transport and communications	78.9
Financial activity	19.4
Real estate activities, renting, engineering and provision of services to businessmen	68.6
Public administration	18.3
Education	1.8
Health care and provision of social aid	3.8
Provision of communal and individual services; cultural and sporting activity	6.7
Total	1,239.8

Source: JICA Survey Team

Consumption expenditure by induced compensation of employees is 0.983 billion UAH calculated by induced compensation of employees (1.24 billion UAH) and average propensity to consume in 2009 (79.3%).

Table 11.1.6 Average Propensity to Consume

	2002	2003	2004	2005	2006	2007	2008	2009
Expenditure and saving total (mil. UAH)	185,073	215,672	274,241	381,404	472,061	623,289	845,641	894,286
Goods and Services Purchasing (mil. UAH)	153,589	180,730	221,713	306,769	385,681	509,533	695,618	709,025
Average Propensity to Consume	83.0%	83.8%	80.8%	80.4%	81.7%	81.7%	82.3%	79.3%

Source: "Household Income and Expenditure", State Statistics Committee of Ukraine

Table 11.1.7 Consumption Expenditures

Sector	Share of Private Consumption Expenditures	Consumption Expenditures (million UAH)
Agriculture, hunting, forestry	0.118	115.7
Fishing, fishery	0.005	5.0
Mining	0.019	18.6
Manufacturing	0.604	593.8
Production and distribution of electricity, gas and water	0.028	27.8
Construction	0.003	2.5
Trade; repair of motor vehicles, household appliances and personal demand items	0.008	8.1
Activity of hotels and restaurants	0.019	18.8
Activity of transport and communications	0.064	62.9
Financial activity	0.007	7.1
Real estate activities, renting, engineering and provision of services to businessmen	0.071	69.4
Public administration	0.001	0.8
Education	0.018	17.9
Health care and provision of social aid	0.014	13.5
Provision of communal and individual services; cultural and sporting activity	0.022	21.3
Total	1.000	983.2

Source: JICA Survey Team

By using the estimated I-O Table for 2010 and Leontief Inverse Matrix and consumption expenditures, secondary effects due to the construction of the New Mykolaiv Bridge are estimated to total 1.376 billion UAH as shown in Table 11.1.8.

Table 11.1.8 Secondary Effects due to the New Mykolaiv Bridge

Sector	million UAH
Agriculture, hunting, forestry	170.4
Fishing, fishery	1.3
Mining	77.2
Manufacturing	555.6
Production and distribution of electricity, gas and water	66.4
Construction	6.9
Trade; repair of motor vehicles, household appliances and personal demand items	155.1
Activity of hotels and restaurants	11.2
Activity of transport and communications	109.5
Financial activity	24.4
Real estate activities, renting, engineering and provision of services to businessmen	129.4
Public administration	5.6
Education	18.8
Health care and provision of social aid	14.9
Provision of communal and individual services; cultural and sporting activity	28.9
Total	1,375.5

Source: JICA Survey Team

(4) Total Effect of Project

Total of direct impacts and primary and secondary effects is estimated at 8.57 billion UAH and 0.79% of GDP of Ukraine in 2010.

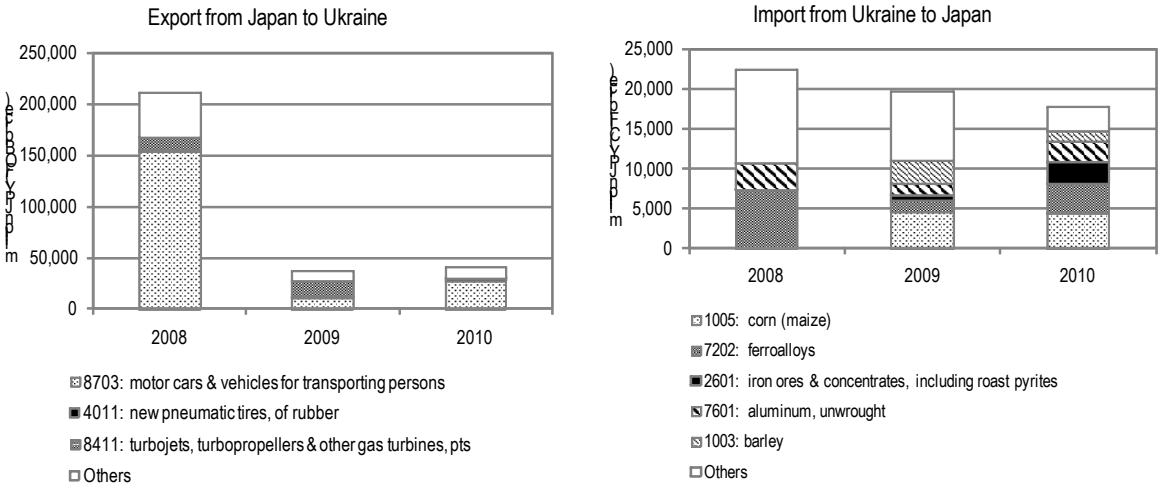
Table 11.1.9 Ripple Effect due to the New Mykolaiv Bridge

	million UAH	% of GDP (2010)
Direct Impacts and Primary Effects	7,192.4	0.664%
Secondary Effects	1,375.5	0.127%
Total	8,567.9	0.791%

(5) Impact on Trade with Japan due to the Project

Figure 11.1.2 shows the trade between Ukraine and Japan in 2008 to 2010 by HS 4 digit classified commodity. Export from Japan to Ukraine is dominated by consumer durables, especially motor cars. Export from Ukraine to Japan, on the other hand, consists of agricultural products and metallic materials.

Table 11.1.10 and Table 11.1.11 show the GDP and trade between Ukraine and Japan and correlation of imports, exports and GDP of Ukraine and Japan from 1999 to 2010. Imports from Japan and GDP of Ukraine show a high correlation.



Source: Trade Statistics of Japan, Ministry of Finance of Japan

Figure 11.1.2 Trade between Ukraine and Japan

Table 11.1.10 GDP and Trade between Ukraine and Japan (current prices)

Year	Imports from Japan (million USD)	Exports to Japan (million USD)	GDP of Ukraine (billion USD)	GDP of Japan (billion USD)
1999	54.09	123.38	31.58	4,368.73
2000	50.85	154.04	31.26	4,667.45
2001	36.72	140.42	38.01	4,095.48
2002	57.85	146.69	42.39	3,918.33
2003	146.99	110.90	50.13	4,229.10
2004	256.99	133.20	64.88	4,605.94
2005	387.86	141.41	86.18	4,552.19
2006	675.26	173.38	107.75	4,362.58
2007	1,083.55	157.08	142.72	4,377.96
2008	2,032.44	216.60	180.12	4,886.95
2009	386.39	209.44	117.40	5,068.89
2010	453.25	453.25	136.42	5,390.90

Source: Trade Statistics of Japan, Ministry of Finance of Japan and World Economic Outlook Database, IMF

Table 11.1.11 Correlation Coefficient of GDP and Trade (1999-2010, current prices)

	Imports from Japan to Ukraine	Exports to Japan from Ukraine	GDP of Ukraine	GDP of Japan
Imports from Japan to Ukraine	1.000			
Exports to Japan from Ukraine	0.231	1.000		
GDP of Ukraine	0.877	0.551	1.000	
GDP of Japan	0.337	0.781	0.604	1.000

Source: JICA Survey Team

The relationship between Ukraine's GDP and imports from Japan is estimated by the following elasticity model. GDP and imports for the model were converted to constant prices in 2010 by the GDP deflators in Ukraine.

$$Log\ (I_{JU}) = -16.349 + 3.645 * Log\ (GDP_U) \qquad (\text{Adjusted } R^2=0.730)$$

where,

I_{JU}: Imports from Japan to Ukraine (million USD in 2010 constant price), and

GDP_U: GDP of Ukraine (million USD in 2010 constant price)

The result of the analysis using the I-O Table regarding the impact of the construction of the new Mykolaiv Bridge is estimated at 0.791% of GDP of Ukraine in 2010. This will bring a 2.91 % increase in imports, especially consumer durables from Japan to Ukraine.

11.1.2 Stock Effect by the Project

(1) Operation and Effect Indicators

Forecasted future traffic volume at the existing Varvarovsky Bridge and the New Mykolaiv Bridge are summarized in Table 11.1.12.

Table 11.1.12 Future Traffic Volume (1,000 vehicles / day)

		2015		2021 (2 years after open)		2030		2045	
		Without Project	With Project	Without Project	With Project	Without Project	With Project	Without Project	With Project
Existing Varvarovsky Bridge	Passenger cars	22.9	12.0	28.7	15.1	40.2	21.1	70.6	37.1
	Buses	4.2	4.2	4.5	4.5	5.0	5.0	5.9	5.9
	2 axle trucks	2.2	1.1	2.4	1.2	2.8	1.4	3.4	1.7
	3 and more axle trucks	1.0	0.5	1.5	0.7	2.3	1.1	2.8	1.3
	Trailers	2.4	1.1	3.2	1.5	4.5	2.1	5.3	2.4
New Mykolaiv Bridge	Passenger cars	-	10.9	-	13.6	-	19.1	-	33.5
	Buses	-	-	-	-	-	-	-	-
	2 axle trucks	-	1.1	-	1.2	-	1.4	-	1.7
	3 and more axle trucks	-	0.5	-	0.8	-	1.2	-	1.5
	Trailers	-	1.3	-	1.7	-	2.5	-	2.9
Total	Passenger cars	22.9	22.9	28.7	28.7	40.2	40.2	70.6	70.6
	Buses	4.2	4.2	4.5	4.5	5.0	5.0	5.9	5.9
	2 axle trucks	2.2	2.2	2.4	2.4	2.8	2.8	3.4	3.4
	3 and more axle trucks	1.0	1.0	1.5	1.5	2.3	2.3	2.8	2.8
	Trailers	2.4	2.4	3.2	3.2	4.5	4.5	5.3	5.3

Note: "With Project" is 100% demand of Ochakov Port and freeway case.

Source: JICA Survey Team

By the operation of the New Mykolaiv Bridge connecting to the M14 Bypass, the number of heavy vehicles through existing Varvarovsky Bridge and the urban area of Mykolaiv city is decreased and the share of heavy vehicles is also decreased.

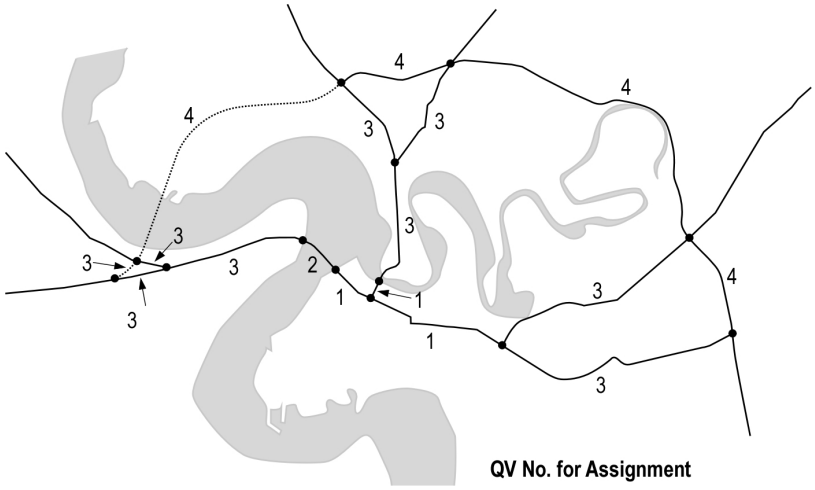
Table 11.1.13 Forecasted Heavy Vehicle Ratio

	2015		2030		2045	
	Without Project	With Project	Without Project	With Project	Without Project	With Project
Existing Varvarovsky Bridge	10.4%	8.2%	12.4%	10.2%	9.2%	7.7%
New Mykolaiv Bridge	-	13.4%	-	15.2%	-	11.1%

Note: "With Project" is 100% demand of Ochakov Port and freeway case.

Note: Heavy vehicles consist of 3 axle and more rigid trucks and trailers.
For the forecasting of future traffic condition such as an average travel speed of "With Project" and "Without Project" cases, forecasted future traffic demand was assigned on road network.
Road network for the traffic assignment is designed as shown in Figure 11.1.3 and Table 11.1.14.

Source: JICA Survey Team



Source: JICA Survey Team

Figure 11.1.3 Road Network for Traffic Assignment and QV Number

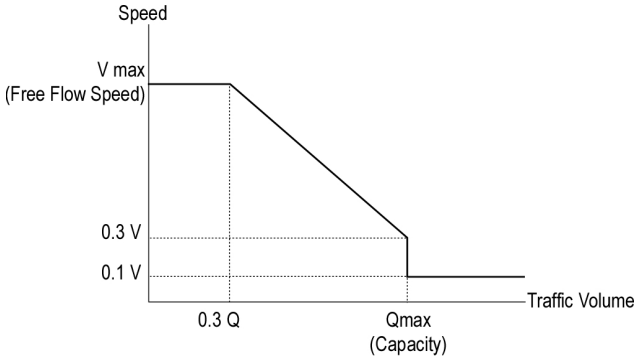
All road links in the network include road length, capacity and free flow speed defined in Table 11.1.14.

Table 11.1.14 Link Condition of Road Network for Traffic Assignment

Area	No. of Lanes	Basic Capacity (pcu/hour)	Peak Ratio	Possible Capacity (pcu/day)	Signal Factor	Assignment Capacity (pcu/day)	Free Flow Speed (km/h)	QV No.
Urabn	4	8,800	7%	125,700	0.6	75,400	50	1
Inner	3	6,600	7%	94,300	0.8	75,400	60	2
	4	8,800	7%	125,700	0.8	100,600	60	3
Outer	4	8,800	7%	125,700	0.9	113,100	80	4

Source: JICA Survey Team

Average travel speed at each road link is calculated by assigned traffic volume and following QV curve. Travel time at each link is calculated by average travel speed and link length.



Source: JICA Survey Team

Figure 11.1.4 Q-V Curve

Table 11.1.15 shows the average travel time by type of vehicle through the existing Varvarovsky Bridge and the New Mykolaiv Bridge. Average travel time saving by the project of heavy vehicles such as 3 axle and more rigid trucks and trailers is expected to be more than 7 minutes in 2030.

Table 11.1.15 Forecast Average Travel Time and Travel Time Savings (minutes / vehicle)

	2015			2030			2045		
	Without Project	With Project	Time Saving	Without Project	With Project	Time Saving	Without Project	With Project	Time Saving
Passenger cars	23.8	20.6	3.2	24.5	22.1	2.5	25.6	23.6	1.9
Buses	26.8	24.6	2.2	27.6	26.6	1.0	27.9	27.5	0.5
2 axle trucks	29.5	24.1	5.4	30.5	25.6	4.9	32.0	27.5	4.5
3 and more axle trucks	32.4	24.9	7.5	33.4	26.4	7.0	34.8	28.3	6.6
Trailers	31.6	23.7	7.9	32.7	25.3	7.4	34.1	27.2	6.9

Note: "With Project" is 100% demand of Ochakov Port and freeway case.

Source: JICA Survey Team

Table 11.1.16 shows the average travel speed of future traffic through existing Varvarovsky Bridge and the New Mykolaiv Bridge. By the operation of the New Mykolaiv Bridge, the average travel speed is expected to increase by more than 10 km/h in 2030.

Table 11.1.16 Forecasted Average Travel Speed (km/h)

	2015			2030			2045		
	Without Project	With Project	Improve -ment	Without Project	With Project	Improve -ment	Without Project	With Project	Improve -ment
Passenger cars	35.4	53.4	18.0	34.3	49.8	15.5	32.0	46.4	13.3
Buses	36.0	39.2	3.2	34.9	36.0	1.1	33.5	34.6	0.4
2 axle trucks	48.2	61.5	13.3	46.7	57.9	11.2	43.4	53.8	9.4
3 and more axle trucks	49.2	62.5	13.3	47.6	59.0	11.4	44.4	55.0	9.8
Trailers	48.5	62.8	14.3	46.9	58.9	12.0	43.6	54.8	10.1

Note: "With Project" is 100% demand of Ochakov Port and freeway case.

Source: JICA Survey Team

Figure 11.1.5 shows the relationship between the CO_2 emission factor and average travel speed by vehicle type in Japan. Based on this figure, daily CO_2 emissions by vehicular traffic through the existing Varvarovsky Bridge and the New Mykolaiv Bridge are estimated by the following formula.

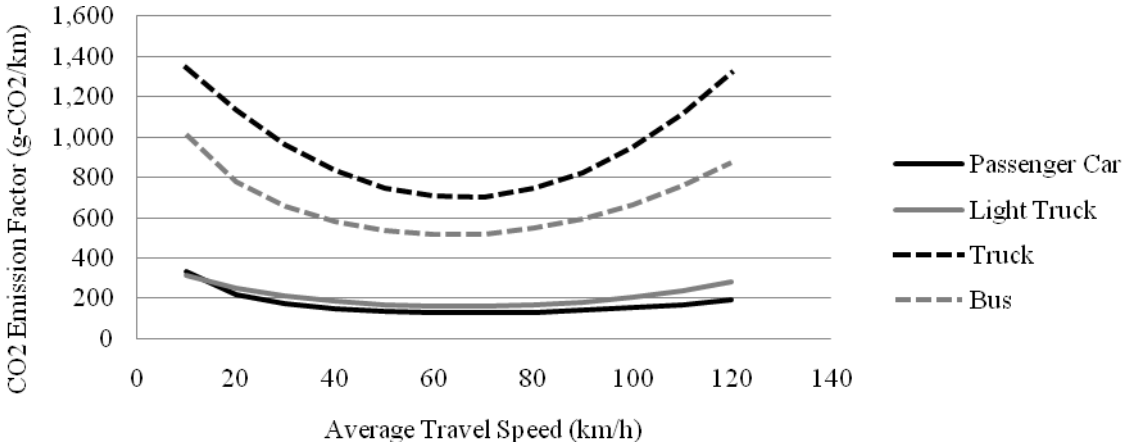
$$CO_2 = \sum EF \times (Veh \times km)$$

where,

CO_2 : CO_2 emissions,

EF : CO_2 emission factor by vehicle type and travel speed, and

Veh*km : Vehicle kilometres travelled by type of vehicle.



Source: Civil Engineering Journal Vol.43 No.11 (Nov. 2001), National Institute for Land and Infrastructure Management, MLIT, JAPAN

Figure 11.1.5 CO_2 Emission Factor of Vehicles

Estimated vehicular CO_2 emissions and expected reduction by the improvement of travel speed in accordance with the project are shown in the following table. CO_2 emissions by passenger cars in "With Project" case is larger than "Without Project" case because of detour to avoid congesting Varvarovsky Bridge and the longer distance travelled. The reduction of vehicular CO_2 emissions, however, is expected to be 7.7 ton per day in 2030 in total for all vehicle types.

Table 11.1.17 Estimated CO_2 Emissions and Reduction by the Project (ton / day)

	2015			2030			2045		
	Without Project	With Project	CO_2 reduction	Without Project	With Project	CO_2 reduction	Without Project	With Project	CO_2 reduction
Passenger cars	52.7	56.8	-4.0	94.0	101.5	-7.5	178.3	185.2	-6.9
Buses	41.4	39.9	1.5	49.7	48.8	0.9	62.7	57.9	4.8
2 axle trucks	8.9	8.7	0.2	11.6	11.3	0.3	14.5	13.9	0.7
3 and more axle trucks	19.9	18.1	1.8	46.6	42.4	4.3	59.3	52.7	6.5
Trailers	46.5	42.1	4.4	89.1	79.4	9.7	108.7	96.3	12.5
Total	169.4	165.5	3.9	290.9	283.2	7.7	423.5	406.0	17.5

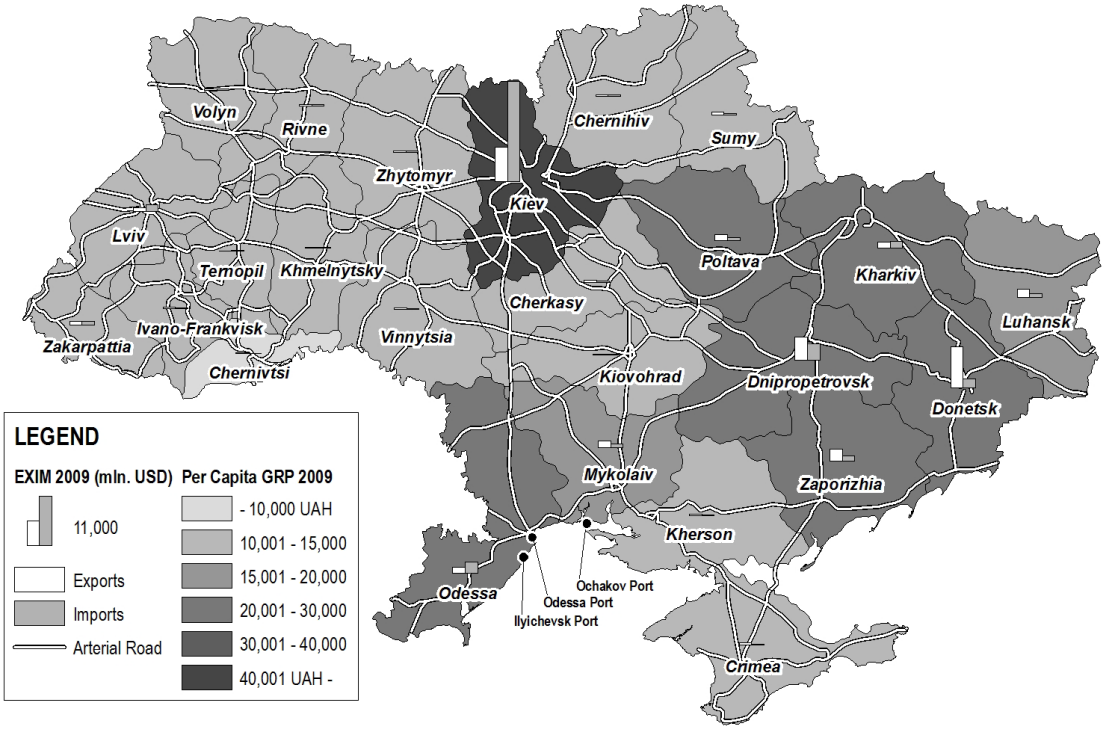
Note: "With Project" is 100% demand of Ochakov Port and freeway case.

Source: JICA Survey Team

(2) Cargo Transport Cost Saving

The New Mykolaiv bridge is, especially, expected to contribute to cost saving of cargo transport between major seaports such as Odessa, Ilyichevsk and Ochakov ports and industrial areas in the eastern part of Ukraine and Kiev where the major center of consumption in Ukraine is located. This traffic is currently passing through Mykolaiv city center and existing Varvarovsky Bridge in spite of the longer travel distance because of heavy vehicle restrictions in the city centre.

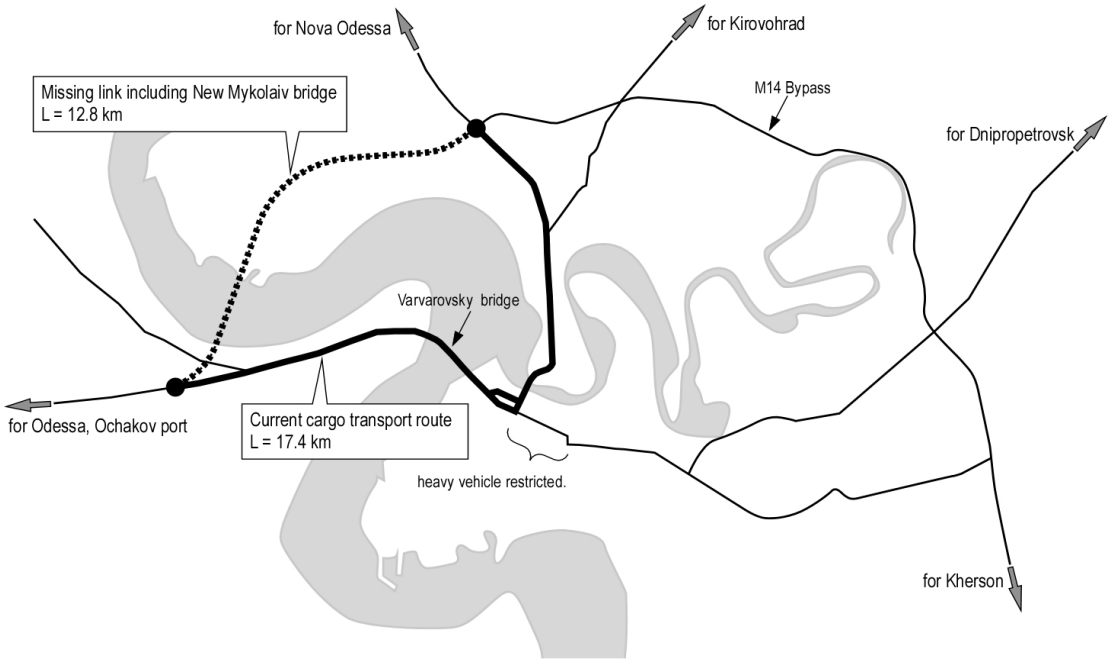
As an effect of the project, reduction of cargo transport cost due to the travel distance reduction by the project is estimated.



Source: State Statistics Committee of Ukraine

Figure 11.1.6 Per Capita Gross Regional Products and Export-Imports by Region in 2009

Cargo transport cost saving is calculated by distance related travel cost of vehicle and travel distance reduction due to the New Mykolaiv bridge. Distance related travel cost of trailers is estimated 4.88 UAH per km as shown in the section on vehicle operating cost in the next session Travel distance reduction due to the New Mykolaiv Bridge is about 4.6 km, therefore, travel cost saving of a trailer is expected to be 22.4 UAH per vehicle.



Source: JICA Survey Team

Figure 11.1.7 Travel Distance Reduction due to the New Mykolaiv Bridge

Transport costs for a 40ft container between Kiev and Japan are estimated based on the factory interview survey by JETRO as shown in Table 11.1.18. Travel cost saving due to the New Mykolaiv Bridge is 0.9% and 0.7% of total transport cost of exports from Kiev to Japan and Imports from Japan to Kiev respectively.

Table 11.1.18 Container Transport Cost Between Japan and Kiev

Route	Transport Cost of 40ft Container	
	USD	UAH
Export: Kiev- Odessa- Yokohama (Japan)	3,050	24,404
Import: Yokohama- Odessa- Kiev	4,200	33,605

Source: Investment cost surveyed by JETRO

11.2 Economic Evaluation for the Project

Economic evaluation of the New Mykolaiv Bridge is conducted by means of a Cost Benefit Analysis (CBA). The CBA is a means-end assessment defined by economic circumstances and where the investment is decided upon the conditioned evaluation cycle where input generates a result.

The CBA in this chapter was made by comparing the case "With Project" and the case "Without Project ". The principle of the evaluation is based on the classic evaluation methodology with “Discounted cash flow”, and “Conversion of the market prices to the economic prices”.

11.2.1 Vehicle Operation Cost

Time value for passengers and crew in the vehicle is calculated by average monthly wage in 2010 as shown in Table 11.2.1. Time value of bus and truck drivers and passengers is about 13.7 UAH per hour and another passenger and private vehicle driver is about 13.0 UAH per hour.

Table 11.2.1 Time Value of Driver and Passengers

	Average of all activities	Truck and Bus Driver (activity of surface transport)
Average monthly wage in 2010 (UHA/month)	2,239.0	2,355.0
Monthly Working Hours (hours / month)	172.0	172.0
Average Hourly Income (UAH / hour / person)	13.0	13.7

Source: JICA Survey Team calculated based on the data of the State Statistics Committee of Ukraine

Vehicle operation cost (VOC) saving is an economical benefit of the project. For the estimation of VOC value, types of vehicles are categorized into 6 groups, namely, motorcycles, passenger cars, busses, 2 axle rigid trucks, 3 and 4 axle rigid trucks and semi/full trailers. In each group, a typical (representative or popular) model available in the market is selected referring to the car dealers' or internet's used-car sites in Ukraine. Information for the calculation of each VOC collected is shown in Table 11.2.2.

Table 11.2.2 Collected Data for VOC (Vehicle Operating Cost) in Ukraine in 2010

	Passenger Car				Bus	2 Axle Truck	3+ Axle Truck	Semi / Full Trailer
Representative Vehicle	Toyota Auris Sol (1.6L)	Daewoo LANOS 1.6 DOHC	Lada 21104-68	Chevrolet Aveo B4XM45C (1.5L)	Mercedes Sprinter 315	Hyundai HD-120	Hyundai HD-270	Mercedes Actros 3341+
New Vehicle Price without Tax (UAH)	164,128	65,664	60,376	94,720	309,783	360,400	701,600	847,909
New Vehicle Price with Tax (UAH)	205,160	82,080	75,470	118,400	387,229	450,500	877,000	1,059,886
Service Life (years)	12	12	10	12	10	12	14	14
Kilometres Driven per Year (km / year)	9,500	9,500	9,500	9,500	36,800	29,700	85,500	85,500
Life time running kilometres (km)	114,000	114,000	95,000	114,000	368,000	356,400	1,197,000	1,197,000
Tire Cost (UHA / 1 set 2 tires)	840	840	840	840	1479	1479	1479	1479
Required number of Tires (incl. Spare)	5	5	5	5	7	7	14	28
Set Price of 1 Tire (UAH)	4,200	4,200	4,200	4,200	10,353	10,353	20,706	41,412
Running Kilometres (km)	40,000	40,000	40,000	40,000	50,000	50,000	50,000	50,000
Tire Cost (UAH/ 1000km)	105	105	105	105	207	207	414	828
Fuel Type used	Petrol	Petrol	Petrol	Petrol	Diesel	Diesel	Diesel	Diesel
Fuel Costs (UAH / litter)	9.82	9.82	9.82	9.82	9.5	9.5	9.5	9.5
Fuel Consumption Rate (km / litter)	16.8	11.4	8.8	10.6	10.1	6.26	5.26	3.34
Oil Costs (UAH / litter)	45.8	45.8	45.8	45.8	45.8	45.8	45.8	45.8
Oil Cost (UAH / 1 time)	183.2	183.2	183.2	183.2	229	320.6	412.2	412.2
Distance between oil changes (km)	10,000	10,000	10,000	10,000	8,000	9,000	10,000	10,000
Car Insurance (UAH/year)	260	260	260	260	260	260	260	260
Annual Maintenance Cost (UAH)	260	260	260	260	292	292	650	650
Spare Parts Ratio (%)	0.83	0.83	0.83	0.83	1	0.83	0.83	0.83
Spare parts Cost (UAH/1000km)	143.4	57.4	52.7	82.8	84.2	100.7	68.1	82.3
Crew Cost (UAH/Month/Psn)	-	-	-	-	2,355	2,355	2,355	2,355

Source: JICA Survey Team

Based on the collected information, VOCs of the 5 vehicle types are calculated as shown in Table 11.2.3. Concerning passenger car, VOC is a weighted average of vehicle composition, namely, car of Japanese is 30%, Russian is 21%, Korean is 18%, American is 12% and others is 19% which are observed by JICA Survey Team at Mykolaiv City.

Table 11.2.3 Unit Cost of Vehicle Operating Cost by Vehicle Type

	Cost Items	unit	Passenger Cars	Buses	2 Axle Trucks	3+ Axle Trucks	Trailers
Time Related VOC	Ave. Crew	Person / Vehicle	-	2.00	1.38	1.23	1.50
	Total Crew Cost	UAH / year	-	56,520	38,999	34,760	42,390
	Maintenance Cost	UAH / year	260	292	292	650	650
	Insurance Cost	UAH / year	260	260	260	260	260
	Depreciation Cost	UAH / year	8,115	27,880	27,030	45,103	54,508
	Sub-Total	UAH / year	8,635	84,953	66,581	80,773	97,808
	Other Cost (10% of sub-total)	UAH / year	863	8,495	6,658	8,077	9,781
	Total	UAH / year	9,498	93,448	73,239	88,850	107,589
		UAH / hour	1.08	10.67	8.36	10.14	12.28
Distance Related VOC	Fuel Cost	UAH / 1000km	835	941	1,518	1,806	2,844
	Oil Cost	UAH / 1000km	18	29	36	41	41
	Tire Cost	UAH / 1000km	105	207	207	414	828
	Maintenance Cost	UAH / 1000km	92	84	101	68	82
	Depreciation Cost	UAH / 1000km	854	758	910	528	638
	Sub-Total	UAH / 1000km	1,904	2,018	2,771	2,857	4,434
	Other Cost (10% of sub-total)	UAH / 1000km	190	202	277	286	443
	Total	UAH / km	2.09	2.22	3.05	3.14	4.88

Source: JICA Survey Team

11.2.2 Time Value

(1) Vehicle with Driver and Passenger

Based on the time related VOC and time value of passengers, time values for each vehicle are calculated as shown in Table 11.2.4. The ratio of business trip including home-base work trip calculated by the results of traffic survey is used for the adjustment factor for passenger car and bus passenger. Time value of trucks and trailers are excluding carried commodity.

Table 11.2.4 Time Value by Vehicle

	Passenger Cars	Buses	2 Axle Trucks	3+ Axle Trucks	Trailers
(A) Time value of passenger (UAH / hour)	13.23	32.29	-	-	-
Vehicle Occupancy (excl. Crew)	2.12	4.14	-	-	-
Average Hourly Income of Passenger (UAH / hour)	13.00	13.00	-	-	-
Adjustment Factor(Ratio of Business trips)	0.48	0.60	-	-	-
(B) Time value of vehicle (incl. Crew Cost)	1.08	10.67	8.36	10.14	12.28
Time Value by Vehicle (A+B) (UAH / hour)	14.31	42.96	8.36	10.14	12.28

Source: JICA Survey Team

(2) Commodities

As a convenient method for calculation of transported commodities' time value, the following formula is used. A concept of this formula is that the money saved due to transport time reduction can be reinvested due to earlier delivery of the cargo.

$$OC = \frac{Vc}{Wc} \times Lw \times Ir$$

Where,

OC: Opportunity Cost of Cargo per Truck,

Vc: Value of Cargo,

Wc: Weight of Cargo,

Lw: Average Loading Weight per Truck, and

Ir: Interest Rate (short-term prime lending rates of banks).

Based on above formula, the time values of commodities in Ukraine are calculated as shown in Table 11.2.5. The unit prices per weight of commodities are calculated using UN trade data. The short-term interest rate is 9.25% p.a. from Ukraine Central Bank as of November 2010.

Table 11.2.5 Time Value of Commodities

Commodity Type	Value of Cargo USD/ton (2008)	Ave Growth Rate of unit price (2000-2008)	Value of Cargo USD/ton (Est 2010)	Time Value of Commodity (USD/ton/hour) in 2010 current price
1. Unprocessed Agricultural Products	385	4.4%	420	0.444
2. Foodstuffs, Beverages	1,114	12.8%	1,418	1.497
3. Animal Feed or Fertilizers	400	21.3%	588	0.621
4. Minerals (Ores)	157	16.7%	214	0.226
5. Chemical Products	2,508	9.2%	2,991	3.159
6. Steel and other Metal Products	921	19.9%	1,325	1.399
7. Machinery and Parts	6,831	9.2%	8,141	8.596
8. Construction Materials	95	8.8%	112	0.119
9. Fabric and Textile Goods	4,645	2.3%	4,864	5.136
10. Pulp, Paper and Printed Matter	1,538	8.8%	1,820	1.922
11. Petroleum	365	17.1%	500	0.528
12. Miscellaneous	1,125	15.8%	1,508	1.592
All Commodities	648	17.7%	897	0.947

Source: JICA Survey Team calculated based on the UN Trade Data

Average time value of loading cargo crossing the Southern Bug River is calculated by weighted average of estimated cargo volume based on the roadside interview survey[1] as shown in Table 4.1.6 and Table 4.1.7.

Table 11.2.6 Time Value of Commodities at Varvarovsky Bridge

2 Axle Trucks	(A) Time Value of Commodity (USD/ton/hr)	Est. Cargo Volume by Road Interview Survey	(B) Share of Loaded Commodity	(C)Ave. loaded ton per vehicle	Weighted average (A*B*C) USD/veh./hr
1. Unprocessed Agricultural Products	0.444	747	13%	15.2	0.88
2. Foodstuffs, Beverages	1.497	2,541	44%	7.0	4.63
3. Animal Feed or Fertilizers	0.621	24	0%	2.0	0.01
4. Minerals	0.226	204	4%	17.0	0.14
5. Chemical Products	3.159	300	5%	2.6	0.43
6. Steel and other Metal Products	1.399	177	3%	8.4	0.36
7. Machinery and Parts	8.596	114	2%	5.2	0.88
8. Construction Materials	0.119	100	2%	10.0	0.02
9. Fabric and Textile Goods	5.136	158	3%	3.0	0.42
10. Pulp, Paper and Printed Matter	1.922	241	4%	3.2	0.25
11. Petroleum	0.528	N/A	N/A	N/A	N/A
12. Miscellaneous	1.592	1,159	20%	3.9	1.26
Total	-	5,764	100%	-	9.27

3+ Axle Trucks	(A) Time Value of Commodity (USD/ton/hr)	Est. Cargo Volume by Road Interview Survey	(B) Share of Loaded Commodity	(C)Ave. loaded ton per vehicle	Weighted average (A*B*C) USD/veh./hr
1. Unprocessed Agricultural Products	0.444	335	5%	11.6	0.27
2. Foodstuffs, Beverages	1.497	1,243	19%	15.2	4.38
3. Animal Feed or Fertilizers	0.621	N/A	N/A	N/A	N/A
4. Minerals	0.226	N/A	N/A	N/A	N/A
5. Chemical Products	3.159	703	11%	20.7	7.13
6. Steel and other Metal Products	1.399	725	11%	22.7	3.57
7. Machinery and Parts	8.596	718	11%	18.4	17.65
8. Construction Materials	0.119	218	3%	16.8	0.07
9. Fabric and Textile Goods	5.136	63	1%	7.0	0.35
10. Pulp, Paper and Printed Matter	1.922	N/A	N/A	N/A	N/A
11. Petroleum	0.528	659	10%	26.4	1.42
12. Miscellaneous	1.592	1,774	28%	17.1	7.48
Total	-	6,438	100%	-	42.32

Semi/Full Trailers	(A) Time Value of Commodity (USD/ton/hr)	Est. Cargo Volume by Road Interview Survey	(B) Share of Loaded Commodity	(C)Ave. loaded ton per vehicle	Weighted average (A*B*C) USD/veh./hr
1. Unprocessed Agricultural Products	0.444	7,719	33%	34.3	4.96
2. Foodstuffs, Beverages	1.497	4,911	21%	21.6	6.71
3. Animal Feed or Fertilizers	0.621	N/A	N/A	N/A	N/A
4. Minerals	0.226	66	0%	11.0	0.01
5. Chemical Products	3.159	672	3%	17.7	1.58
6. Steel and other Metal Products	1.399	1,682	7%	18.7	1.85
7. Machinery and Parts	8.596	589	2%	12.5	2.68
8. Construction Materials	0.119	3,786	16%	22.8	0.43
9. Fabric and Textile Goods	5.136	50	0%	10.0	0.11
10. Pulp, Paper and Printed Matter	1.922	N/A	N/A	N/A	N/A
11. Petroleum	0.528	624	3%	26.0	0.36
12. Miscellaneous	1.592	3,608	15%	18.5	4.48
Total	-	23,706	100%	-	23.17

Source: JICA Survey Team

[1] Roadside Interview Survey on December 2010 by JICA Survey Team

Table 11.2.7 shows the time value of loaded commodities by type of truck including empty trucks. The empty truck ratio is the result of the traffic survey at the existing Varvarovsky Bridge.

Table 11.2.7 Time Value of Loaded Commodities per Truck

	2 Axle Trucks	3+ Axle Trucks	Trailers
Time value (USD/vehicle/hour)	9.27	40.9	22.8
Loading Truck Ratio	85.7%	72.2%	83.2%
Time value of loaded commodity incl. empty trucks (USD/vehicle/hour)	7.95	29.55	19.99

Source: JICA Survey Team

(3) Time Value by Vehicle

As a result, time values including passengers and crew, vehicle and loaded commodities are calculated as shown in Table 11.2.8.

Table 11.2.8 Time Value by Type of Vehicle

	UAH/vehicle/hour
Passenger Cars	14.3
Buses	43.0
2 Axle Trucks	71.7
3+ Axle Trucks	253.9
Trailers	166.1

Source: JICA Survey Team

11.2.3 Assumptions for Economic Analysis

(1) With Project and Without Project

In the Benefit-Cost Analysis, two scenarios, "With Project" and "Without Project" are assumed to evaluate the proposed New Mykolaiv Bridge construction. Through comparison of these two scenarios, it is examined whether or not the benefit of savings in transport costs "with project" could recover the costs of the proposed project from the viewpoint of the national economy.

(2) Implementation Schedule and Project Life

The Project life is considered to be 30 years after the opening of the new Mykolaiv Bridge to the public in 2019, which will take it to 2048 and it is expected that there will be an 8 year construction period between 2012 and 2019.

(3) Exchange rate

Base year of the Project is 2011 and the adopted exchange rates are follows.

- 1 USD = 7.97 UAH
- 1 USD = 79.5 JPY

(4) Discount Rate

The World Bank classifies Ukraine as a "Lower Middle Income" country based on the GNI (Gross National Income). On the other hand, ADB defines the discount rate as 12% for developing countries (GNP growth rate is more than 6%) or 8% for middle class countries (GNP growth rate is less than 6%). For the economic analysis of this project in Ukraine, an 8% discount rate is adopted taking into account the definition of the World Bank and ADB.

(5) Evaluation Criteria

As the indicators of the economical feasibility of the project, the following indicators are calculated.

Economic Internal Rate of Return (EIRR): The rate of return that would be achieved on all project resource costs, where all benefits and costs are measured in economic prices. The EIRR is calculated as the rate of discount for which the present value of the net benefit stream becomes zero, or at which the present value of the benefit stream is equal to the present value of the cost stream. For a project to be acceptable the EIRR should be greater than the economic opportunity cost of capital.

$$\sum_{t=0}^{n} \frac{B_t - C_t}{(1+r_i)^t} = 0$$

where,

n: Evaluation period,

Bt: Benefit at year "t",

Ct:Cost at year "t", and

ri: EIRR.

Net Present Value (NPV): The difference between the present value of the benefit stream and the present value of the cost stream for a project. The net present value calculated at the Banks discount rate should be greater than zero for a project to be acceptable.

$$NPV = \sum_{t=0}^{n} \frac{B_t - C_t}{(1+r)^t}$$

where,

n: Evaluation period,

B_t: Benefit at year "t",

C_t:Cost at year "t", and

r: Discount rate.

Benefit Cost Ratio (BC Ratio): The ratio of the present value of the economic benefit stream to the present value of the economic costs stream, each discounted at the economic opportunity cost of capital. The ratio should be greater than 1.0 for a project to be acceptable.

$$BCRatio = \frac{\sum_{t=0}^{n} \frac{B_t}{(1+r)^t}}{\sum_{t=0}^{n} \frac{C_t}{(1+r)^t}}$$

where,

n: Evaluation period,

B_t: Benefit at year "t",

C_t:Cost at year "t", and

r: Discount rate.

11.2.4 Project Cost

(1) Project Cost

As the result of the cost estimation and project schedule, initial investment cost during the construction period is estimated as shown in Table 11.2.9.

Table 11.2.9 Initial Investment Cost (Market Price)

		2012	2013	2014	2015	2016	2017	2018	2019	2020	Total (million UHA)
Initial Investment Cost	F.C.										
	L.C.										
Total											

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Source: JICA Survey Team

(2) Maintenance Cost

Operation and maintenance cost for the project is estimated as shown in the following table. Unit cost for road operation and maintenance is calculated by road maintenance budget and road length of SRA in 2009. Unit operation and maintenance cost for bridge is based on the example in Japan.

Table 11.2.10 Operation and Maintenance Cost (Market Price)

Year	O&M Cost for Road		O&M Cost for Bridge		Total ('000 UAH)
	O&M	Overlay	O&M	Repair	
1st	931[1)]		26[4)]	0	957
2nd	931		26	0	957
3rd	931		26	0	957
4th	931		26	0	957
5th	931		26	0	957
6th	931		26	0	957
7th	931		26	0	957
8th	931		26	0	957
9th	931		26	0	957
10th	931	55,750[2)]	26	3,072[5)]	59,779
11th	931		26	0	957
12th	931		26	0	957
13th	931		26	0	957
14th	931		26	0	957
15th	931		26	765[6)]	1,722
16th	931		26	0	957
17th	931		26	0	957
18th	931		26	0	957
19th	931		26	0	957
20th	931	55,750	26	18,447[7)]	75,154
21st	931		26	0	957
22nd	931		26	0	957
23rd	931		26	0	957
24th	931		26	0	957
25th	931		26	101,794[8)]	102,751
26th	931		26	0	957
27th	931		26	0	957
28th	931		26	0	957
29th	931		26	0	957
30th	931	139,375[3)]	26	6,132[9)]	146,464

1) 931,000UAH: UKRAVTODOR routine Maintenance Cost / km = 14,155,260/169,500 = 83,500UAH/km, Road Length 11.15km x 83,500UAH/km=931,000UAH /every year
2) 55,750,000UAH: Pavement Overlay 25m (B) x 1,000m (L) x 200UAH = 5,000,000UAH/km, Road Length 11.15km x 5,000,000UAH/km=55,750,000UAH /every 10 year
3) 139,375,000UAH: Pavement Renewal 25m (B) x 1,000m (L) x 500UAH = 12,500,000UAH/km, Road Length 11.15km x 12,500,000UAH/km=139,375,,000UAH /every 30 year
4) 26,000UAH: Road Lighting Maintenance (25% of Renewal/year) from 6), 3,060,000UAH/30 years x 0.25=26,000 UAH/year
5) 3,072UAH: Repainting for Main Bridge Guardrail (4,080 m^2 x 300 UAH/m^2= 1,224,000 UAH) and Approach Bridge Guardrail (6,160 m^2 x 300 UAH/m^2)= 1,848,000 UAH = 3,072,000 UAH/ every 10 year
6) 765,000UAH: Road Lighting Maintenance (25% of Renewal) Renewal 30 Nos. x 30,000 UAH/No= 3,060,000 UAH, 3,060,000 UAH x 0.25=765,000 UAH/ every 15 year
7) 18,447,000UAH: Repainting for Main Bridge Guardrail (4,080 m^2 x 300 UAH/m^2= 1,224,000 UAH) and Approach Bridge Guardrail (6,160 m^2 x 300 UAH/m^2)= 1,848,000 UAH = 3,072,000 UAH/ every 10 year ; Overlay for Pavement 51,250 m^2 x 300 UAH= 15,375,000 UAH/ every 20 year; 3,072,000 + 15,375,000= 18,447,000 UAH/ every 20 year;
8) 101,794,000UAH: Replacement of all Expansion Joint; 201.6m x 50,000UAH= 10,080,000UAH/ every 25 year; Repainting of Main Bridge Girder (63,156 m^2 x 500 UAH/m^2= 31,578,000 UAH) and Approach Bridge Girder (120,272 m^2 x 500 UAH/m^2)= 60,136,000 UAH = 91,714,000 UAH/ every 25 year; 10,080,000 + 91,714,000= 101,794,000 UAH/ every 25 year
9) 6,132,000UAH: Road Lighting Renewal 102 Nos. x 30,000UAH/No = 3,060,000 UAH/ ever 30 year; Repainting for Main Bridge Guardrail (4,080 m^2 x 300 UAH/m^2= 1,224,000 UAH) and Approach Bridge Guardrail (6,160 m^2 x 300 UAH/m^2)= 1,848,000 UAH = 3,072,000 UAH/ every 10 year ; 3,060,000 + 3,072,000 = 6,132,000 UAH/ ever 30 year

Source: JICA Survey Team

(3) Economic Price of Project Cost

For the economic analysis, all project costs and benefits should be valued at their opportunity costs to the economy. For this purpose, international prices (border prices) are taken to be the most appropriate measures of opportunity cost. It should be noted that price distortion intentionally caused by imposition or limited opportunity needs to be adjusted to shadow price.

Theoretically, the shadow pricing exercise requires a large amount of data and information such as historical data regarding foreign exchange, taxes, wages by various industries, price data of exported and imported goods as well as those in the domestic market, etc. Since it was not easy to obtain such information in a short period, a standard conversion factor (SCF) was prepared as a compatible tool to convert the financial prices to the economic prices.

At the economic analysis of the Project, project cost is divided into tradable goods or non-tradable goods, and corresponds to foreign currency and local currency respectively. Economic price of non-tradable goods is calculated by following SCF.

$$SCF = \frac{I / E}{(I + Di) + (E - De)}$$

Where,

I: Imports in C.I.F. price,

E: Exports in F.O.B. price,

Di: Import Duties, and

De: Export Duties

Based on above formula and following figures in the table, SCF in 2009 of Ukraine is 0.983.

Table 11.2.11 EXIM Duties of Ukraine

	2008	2009
Merchandise exports (million US$ at current price)	66,954	39,703
Taxes on exports (million USD at current price)	37	49
Merchandise imports (million US$ at current price)	85,535	45,436
Customs and other import duties (million USD at current price)	2,298	840
Standard Conversion Factor (SCF)	0.974	0.983

Source: "World Development Indicators", World Bank

11.2.5 Benefits of Project

The direct economic benefits are calculated by the reduction in travel cost and time saving of road users between "With Project" and "Without Project". To estimate the benefit of the project, future traffic volumes by vehicle type are assigned on the routes (existing Varvarovsky Bridge or New Mykolaiv Bridge) , and "vehicle-distance travelled" and "vehicle-hour" are calculated.

Benefits due to travel distance reduction is calculated by distance related VOC and difference of total distance travelled between "With Project" and "Without Project". Benefits by travel time saving are also calculated by Time Value and difference of total travel time between "With Project" and "Without Project". Travel time at the existing Varvarovsky Bridge in each case includes waiting time for vessels passing the bridge calculated by the following formula.

$$W = \frac{V \times T}{2} \times D \times Nv$$

Where,

W: Waiting time in vehicle-hour / day

V : Number of vehicles arriving during vessel passing (7% of daily traffic volume which is average hourly traffic volume ratio in 7:00 - 18:00),

T: Closed time by vessel passing (1 hour/vessel),

D: Direction (both, 2 directions), and

Nv: Number of vessels per day (33 vessels in 2009 / 365 days = 0.09 vessels per day)

Project benefits are calculated by the demand forecast case with a toll system, as shown in the following table, and demand of Ochakov Port development.

Table 11.2.12 Assumed Toll Structure for New Mykolaiv Bridge

	Toll Structure (UAH/vehicle)			
	Free	Toll-1	Toll-2	Toll-3
Passenger Cars	0	10	20	30
2 Axle Trucks	0	15	30	45
3+ Axle Trucks	0	20	40	60
Trailers	0	30	60	90

Source: JICA Survey Team

The following table shows the estimated socio-economic benefit, which consists of travel cost and travel time saving, by demand forecast cases. Socio-economic benefits by the project are calculated by the following formula.

$$B = (\sum DTe - \sum DTp) \cdot VOC + (\sum TTe - \sum TTp) \cdot TV$$

Where,

B: Benefits by the project,

DTe : Distance travelled of "Without Project" case,

DTp: Distance travelled of "With Project" case,

VOC: Distance related vehicle operating cost,

TTe : Travel time of "Without Project" case,

TTp: Travel time of "With Project" case, and

TV: Time value of vehicle.

Table 11.2.13 Estimated Project Benefit (1,000 UAH/day)

	Year	Free	Toll-1	Toll-2	Toll-3
Case 1(100% demand at Ochakov Port capacity)	2015	1,316	1,376	760	399
	2030	6,347	4,262	3,925	3,526
	2045	8,177	5,350	6,437	5,401
Case 2 (75% demand at Ochakov Port capacity)	2015	1,271	1,331	966	372
	2030	6,389	3,949	3,623	3,279
	2045	8,177	5,350	6,437	5,401
Case 3 (50% demand at Ochakov Port capacity)	2015	1,187	1,253	1,018	319
	2030	5,424	3,581	3,287	2,999
	2045	7,856	6,068	5,856	4,914
Case 4 (No induced traffic demand at Ochakov Port)	2015	1,104	1,107	1,072	275
	2030	2,667	2,509	1,367	1,065
	2045	5,869	4,726	3,917	3,146

Source: JICA Survey Team

11.2.6 Results of Economic Analysis

Based on the above assumptions, an economic analysis was conducted with the results as shown in Table 11.2.14. The EIRR was calculated as 18.5% and NPV as 7,546 million UAH in the case of 100% demand from Ochakov port capacity and the freeway. In the case of a toll-way, EIRR and NPV are decreased in accordance with the toll fare.

Table 11.2.14 Results of Cost Benefit Analysis

		Evaluation Indicator		
		Net Present Value (at discount rate 8%, million UAH)	EIRR	B/C (at discount rate 8%)
Case 1 (100% demand of Ochakov port capacity)	Free	7,546	18.5 %	3.22
	Toll-1	4,390	15.5 %	2.29
	Toll-2	3,771	13.8 %	2.11
	Toll-3	3,419	12.7 %	2.01
Case 2 (75% demand of Ochakov port capacity)	Free	7,395	18.3 %	3.18
	Toll-1	4,000	14.9 %	2.18
	Toll-2	3,709	13.9 %	2.09
	Toll-3	3,097	12.3 %	1.91
Case 3 (50% demand oft Ochakov port capacity)	Free	6,309	17.0 %	2.86
	Toll-1	3,823	14.3 %	2.12
	Toll-2	3,201	13.3 %	1.94
	Toll-3	2,446	11.5 %	1.72
Case 4 (No induced traffic demand at Ochakov Port)	Free	2,534	12.3 %	1.75
	Toll-1	2,022	11.8 %	1.59
	Toll-2	368	8.7 %	1.11
	Toll-3	-370	7.3 %	0.89

Source: JICA Survey Team

Table 11.2.15 Economic Cash Flow (100% demand of Ochakov Port, Freeway)

	Economic Cost (million UAH.)			Benefit (million UAH/year)					Net Cash Flow	NPV
	Total	Investment Cost	O&M Cost	Total	Bus	Car	Truck	Trailer		
2011				0.0					0.0	0.0
2012				0.0					-4.2	-3.9
2013				0.0					-99.0	-84.9
2014				0.0					-66.6	-52.9
2015				0.0					-1,060.1	-779.2
2016				0.0					-1,237.5	-842.2
2017				0.0					-1,131.7	-713.2
2018				0.0					-1,009.6	-589.1
2019				422.0	60.4	58.4	149.1	154.2	-21.2	-11.5
2020				802.4	109.8	115.0	284.6	293.0	708.2	354.3
2021				890.4	116.4	132.1	316.9	324.9	889.4	412.0
2022				988.5	123.5	151.8	352.9	360.3	987.5	423.5
2023				1,097.9	130.9	174.4	393.0	399.5	1,096.9	435.6
2024				1,219.9	138.9	200.4	437.7	443.0	1,219.0	448.2
2025				1,356.1	147.3	230.3	487.4	491.2	1,355.2	461.4
2026				1,508.2	156.2	264.6	542.8	544.7	1,507.2	475.1
2027				1,678.0	165.6	304.0	604.4	603.9	1,677.0	489.5
2028				1,867.7	175.7	349.2	673.1	669.7	1,808.9	488.9
2029				2,079.7	186.3	401.2	749.6	742.5	2,078.7	520.2
2030				2,316.7	197.6	461.0	834.8	823.3	2,315.8	536.6
2031				2,330.2	188.0	428.9	854.6	858.8	2,329.3	499.7
2032				2,348.4	178.8	399.1	874.8	895.7	2,347.5	466.3
2033				2,371.2	170.1	371.3	895.5	934.2	2,369.5	435.9
2034				2,398.5	161.9	345.4	916.8	974.4	2,397.6	408.3
2035				2,430.2	154.0	321.4	938.5	1,016.3	2,429.3	383.1
2036				2,466.3	146.5	299.0	960.7	1,060.1	2,465.4	360.0
2037				2,506.8	139.4	278.2	983.5	1,105.7	2,505.8	338.8
2038				2,551.5	132.6	258.9	1,006.8	1,153.2	2,477.6	310.2
2039				2,600.5	126.2	240.8	1,030.6	1,202.8	2,599.6	301.3
2040				2,653.8	120.1	224.1	1,055.0	1,254.6	2,652.8	284.7
2041				2,711.3	114.2	208.5	1,080.0	1,308.6	2,710.4	269.3
2042				2,773.1	108.7	194.0	1,105.6	1,364.9	2,772.2	255.1
2043				2,839.3	103.4	180.5	1,131.8	1,423.6	2,738.2	233.3
2044				2,909.7	98.4	167.9	1,158.6	1,484.8	2,908.8	229.5
2045				2,984.6	93.6	156.2	1,186.1	1,548.7	2,983.6	217.9
2046				3,063.9	89.0	145.4	1,214.2	1,615.3	3,062.9	207.2
2047				3,147.7	84.7	135.2	1,243.0	1,684.8	3,146.8	197.1
2048				3,236.1	80.6	125.8	1,272.4	1,757.3	3,092.1	179.3
									EIRR	18.5%
									NPV	7,546
									B/C Ratio	3.22

Source: JICA Survey Team

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11.2.7 Sensitivity Analysis

Cost overruns and lower traffic demand are considered as major risks that could affect the results of the economic analysis of the project. The following patterns of sensitivity analysis were conducted.

- Initial investment cost: +10%,
- Operation and maintenance cost: +10%,

- Traffic demand: -10%, and
- Initial investment cost, operation and maintenance cost; +10%.

Summary of the sensitivity analysis is shown in Table 11.2.16.

Table 11.2.16 Summary of Sensitivity Analysis (100% demand of Ochakov Port, Freeway)

	Sensitivity Analysis Cases				
	Base Case	Case A	Case B	Case C	Case D
Initial Investment Cost	-	+10%	-	-	+10%
O&M Cost	-		+10%	-	+10%
Traffic Demand	-		-	-10%	-
EIRR	18.5%	17.4%	18.5%	16.8%	17.4%

Note: The case of 100% demand of Ochakov port capacity and free.

Source: JICA Survey Team

11.3 Financial Analysis

11.3.1 Assumptions

(1) Implementation Schedule and Project Life

In the same manner as for the economic analysis, the Project life is considered to be 30 years after the opening of the new Mykolaiv Bridge to the public in 2019, which will take it up to 2048 and it is expected that there will be an 8 year construction period between 2012 and 2019.

(2) Evaluation Criteria

FIRR: The rate of return that would be achieved on all project costs, where all costs are measured in financial prices and when benefits represent the financial revenues that would accrue to the main project participant. The FIRR is the rate of discount for which the present value of the net revenue stream becomes zero, or at which the present value of the revenue stream is equal to the present value of the cost stream. It should be compared with the opportunity cost of capital, or the weighted average cost of capital, to assess the financial sustainability of a project.

11.3.2 Project Cost

(1) Initial Investment Cost

Initial investment cost of the project for the financial analysis is the financial price of the items listed in the initial investment cost table, which is shown in the economic analysis.

(2) Maintenance Cost

Project maintenance cost for the financial analysis is the financial price of items listed in the maintenance cost table, which is shown in the economic analysis.

11.3.3 Benefits of Project

In the financial analysis, toll revenue is counted as a project benefit. Forecasted toll revenues based on the forecasted future traffic volumes and toll system at the New Mykolaiv Bridge are shown in Table 11.3.1.

Table 11.3.1 Toll Revenue (million UAH/year)

	Year	Toll-1	Toll-2	Toll-3
Case 1 (100% demand at Ochakov Port capacity)	2015	45.8	62.8	61.3
	2030	81.2	111.7	115.0
	2045	123.6	165.0	159.3
Case 2 (75% demand at Ochakov Port capacity)	2015	45.8	60.6	58.0
	2030	78.3	105.9	104.0
	2045	123.6	165.0	159.3
Case 3 (50% demand at Ochakov Port capacity)	2015	45.1	59.1	58.0
	2030	74.6	100.0	98.6
	2045	119.9	159.9	151.7
Case 4 (No induced traffic demand at Ochakov Port)	2015	44.0	59.1	55.8
	2030	67.0	89.1	87.6
	2045	107.5	139.4	129.8

Source: JICA Survey Team

11.3.4 Results of Financial Analysis

The results of the financial analysis, as shown in Table 11.3.2, indicate that the annual toll revenue is expected to compensate for the annual maintenance cost, however, FIRR including initial investment cost was not available in all cases. It was same result as in the case of 50 years for the project evaluation.

Table 11.3.2 Results of Financial Analysis

		Evaluation Indicator	
		Net Present Value (at discount rate 8%, million UAH)	FIRR
Case 1 (100% demand of Ochakov port capacity)	Toll-1	-2,950	N/A
	Toll-2	-2,771	N/A
	Toll-3	-2,769	N/A
Case 2 (75% demand of Ochakov port capacity)	Toll-1	-2,959	N/A
	Toll-2	-2,795	N/A
	Toll-3	-2,812	N/A
Case 3 (50% demand oft Ochakov port capacity)	Toll-1	-2,976	N/A
	Toll-2	-2,823	N/A
	Toll-3	-2,838	N/A
Case 4 (No induced traffic demand at Ochakov Port)	Toll-1	-3,017	N/A
	Toll-2	-2,879	N/A
	Toll-3	-2,900	N/A

Source: JICA Survey Team

Table 11.3.3 Financial Cash Flow (100% demand of Ochakov Port, Toll-2)

	Expenditure (million UAH.)			Revenue (million UAH/year)	Net Cash Flow	NPV
	Total	Investment Cost	O&M Cost			
2011				0.0	0.0	0
2012				0.0	-4	-4
2013				0.0	-100	-86
2014				0.0	-67	-53
2015				0.0	-1076	-791
2016				0.0	-1256	-855
2017				0.0	-1142	-720
2018				0.0	-1017	-593
2019				42.7	-404	-218
2020				76.1	-19	-10
2021				79.0	78.1	36
2022				82.1	81.2	35
2023				85.4	84.4	34
2024				88.7	87.7	32
2025				92.2	91.2	31
2026				95.8	94.8	30
2027				99.5	98.6	29
2028				103.4	43.7	12
2029				107.5	106.5	27
2030				111.7	110.7	26
2031				114.6	113.7	24
2032				117.7	116.7	23
2033				120.8	119.0	22
2034				123.9	123.0	21
2035				127.2	126.2	20
2036				130.6	129.6	19
2037				134.0	133.0	18
2038				137.5	62.4	8
2039				141.1	140.2	16
2040				144.9	143.9	15
2041				148.7	147.7	15
2042				152.6	151.6	14
2043				156.6	53.9	5
2044				160.7	159.8	13
2045				165.0	164.0	12
2046				169.3	168.4	11
2047				173.8	172.8	11
2048				178.4	31.9	2
					FIRR	#DIV/0!
					NPV	-2771
					B/C Ratio	0.19

Source: JICA Survey Team

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11.4 Other Project Impacts

Construction of the New Mykolaiv Bridge will induce Direct, Primary and Secondary economic effects as stated in "11.1 Effects of the Project" in general. The local government and business communities in Mykolaiv Region are also expecting huge project impacts especially on their local economy.

In addition to these economic impacts, one of the positive impacts for the people in Mykolaiv is improvement of their environmental situation, such as less air pollution and noise caused by heavy vehicles. On the other hand, one of the main negative impacts is water contamination of the Southern Bug River during the construction stage, which should be carefully mitigated.

Regarding air pollution and noise caused by heavy vehicles, it is recommended to initiate a baseline survey along the trunk road M-14 in Mykolaiv city before the construction stage. The followings are examples of the items to be included in the baseline study.

Air Pollution Survey

Pollutants: CO, NO, SO_2

Survey Points: 3 sites along M-14 (inside of Mykolaiv city)

Timing: 3 times Morning, Noon, Evening

Noise Survey

Detection: Equivalent Continuous Service Level (Leq)

Survey Points: 3 sites along M-14 (inside of Mykolaiv city)

Timing: 1 whole day (24 hours continuous measurement)

This project will also have an impact on the Japan-Ukrainian economic relationship because of activating agricultural and mineral imports from Odessa and Ochakov ports through the Mykolaiv Bridge as stated in Chapter 2.4 and Chapter 11. 1.

11.5 Justification of the Project

11.5.1 Necessity of the Project

National road M-14 is a part of the international transport corridor between Europe and Asia (called the Eurasian corridor) and is also a part of the international corridor of the Black Sea Economic Cooperation (BSEC) connecting Romania, Moldova and Russia through Mykolaiv City. The amount of cargo transported over M-14, especially in Mykolaiv region, will increase with development of Ochakov port, in addition to the current role of the road connecting the international port of Odessa in south-western Ukraine and industrialized cities along Dnieper River in south-eastern Ukraine.

In spite of the importance of M-14, the current route has a traffic bottleneck at the western part of Mikolaiv city where the road crosses the Southern Bug River over a rotating bridge, called Varvarovsky Bridge. At the bridge, the number of vehicles in 2010 was calculated to be 11,000 per day in winter and 54,000 in summer, and around 30% of them were heavy vehicles. Currently, Mykolaiv city is trying to maintain and renovate public transportation to be more ecologically sound by upgrading the tram and trolley buses, however, the actual situation is getting worse because of traffic jams, noise and air pollution caused by heavy vehicles.

This project is to provide an M-14 bypass road in Mikolaiv including construction of the new Mykolaiv Bridge over the Southern Bug River. It is expected that the Project will promote

local employment and activate the local economy in Mykolaiv region in addition to the expectation of resolving the above issues.

11.5.2 Expected Benefits to Japan

Japan is endeavouring to improve its food self-sufficiency ratio and diversification of food imports for emergency food supply. In April 2004, the Ministry of Foreign Affairs and the Ministry of Agriculture, Forestry and Fisheries in Japan established the "International Conference on Investment Promotion for Food Security" for stability in food supply. The purpose of the conference was to achieve diversification of sources of food imports by "promoting overseas investment in grain production, pick-up and logistics" under public-private partnership.

Ukraine, a country with fertile land, has promoted a market-oriented economy since 1991. Ukraine is one of the important countries in regard to food supply to strengthen Japan's food security. Ukraine's trade balance with Japan up to September, 2010 was a deficit of 440 million U.S. dollars. In order to ease such trade imbalances, investment in the agricultural sector from Japan and import of foods from Ukraine should be encouraged.

Ukraine is also important for Japan as one of the countries for diversification of sources of mineral imports. Mykolaiv Bridge is in a strategic position in relation to land and maritime transport. Therefore, the construction of the Mykolaiv Bridge is important for both countries. Japan will enjoy significant benefits from the project.

11.5.3 Technical Feasibility

Considering the navigation requirements , as well as topographic and geometric conditions at the selected location for the bridge the applicable bridge type for Mykolaiv main bridge is a suspension bridge as stated in Chapter 5.

In consequence of the preliminary design, the centre span of the main bridge shall be 510 m long, and the height of the pylons and depth of the pylon's steel pipe sheet pile substructure will be around 90 m and 37 m respectively. The locations of the anchors are on land at the right bank and in the water at the left bank, The spans of the approach bridges will be 45～56m with steel I type girders, and the foundation for the piers will be made of steel pipe piles.

The technical feasibility of the main bridge construction is sufficiently high because the design method for suspension bridges of this scale is established and there is no pronounced issue with execution of the construction work. However, it is recommended to adopt international tender for procurement of the consultants and contractor(s) considering the lack of experience with suspension bridges among local consultants and contractors in Ukraine.

Regarding the environmental aspect, it is necessary to prevent river contamination and to protect fishery resources during the bridge construction work as stated in Chapter 6. The construction schedule for the bridge section must reflect these restrictions on river work from the environmental aspects as well as the navigation closing in winter.

According to a letter from International Airport Mykolaiv, they have no objection and no restriction regarding dimensions of the bridge indicated in Figure 5.3.5. However, obstruction markings on the pylons shall be required and exact location and dimensions of pylons shall be submitted to the Airport at the next design stage for their approval.

11.5.4 Economic Feasibility

Travel time and travel cost reduction are the main effects of the Mykolaiv Bridge project as stated in the first half of this chapter.

The average daily traffic in 2010 was around 27,600 at the existing bridge on the Southern Bug River in Mykolaiv city. Based on the GDP growth rate of Ukraine (3.7～4.8% : by IMF), the future traffic demand is estimated to be 37,400 in 2020, and 71,400 in 2040. Economic Internal Rate of Return (EIRR) is 18.6% (toll free and 100% demand of Ochacov port capacity case) based on the benefits and the project cost shown in Chapter 9. The benefits are calculated from the effect of travel time and cost reduction for the vehicles whose drivers choose the new Mykolaiv Bridge instead of the existing bridge (based on the result of traffic interview survey done by JICA Survey Team).

The discount rate for Ukraine is 12% (percentage for "low middle income country") by the World Bank (WB) and 8% (percentage for "middle class country) by the Asian Development Bank (ADB). Compared to these discount rates, EIRR calculated for this project is sufficiently high, therefore the economic feasibility of the Project is positive and the Project is economically viable.

11.6 Conclusions

In this preparatory survey, the objective, outline, cost, schedule, procurement method, execution, maintenance and operation structure and environmental issues of the Mykolaiv bridge project, requested by the Ukrainian side, are clarified through field survey and review of the existing feasibility studies. An implementation plan for the Project is also proposed in order to provide basic data for appraisal of a Japanese Yen Loan application.

As the consequence of this survey, it is concluded that:

(1) The Project is technically and economically feasible

(2) The location of the Mykolaiv Bridge shall be the same location selected by the "Feasibility Study in 2003" (Route 2). However, the alignment of the approach road has to be adjusted considering the latest city plan of Mykolaiv.

(3) The minimum navigation width at the bridge site shall be 240m according to the recommendation by the State Enterprise "Ukrainian Water Ways" who has authority to specify the navigation clearance for every river. Considering this minimum navigation width, a suspension type bridge with centre span of 510m is most appropriate for the main bridge as shown by a comprehensive evaluation that considered construction cost, navigation safety, merits for Ukraine (less environmental effects and possibility of technical transfer), aesthetic features, construction difficulty and maintenance cost.

(4) The execution agency for this project will be the State Road Administration of Ukraine (Ukravtodor). In case of applying a Japanese Yen Loan, it is expected the procurement of consultants for basic design and preparation of tender documents will be scheduled in July 2013, and procurement of a contractor(s) for construction of the bridge will be scheduled in March 2015.

11.7 Recommendations

As a consequence of this survey, the following are recommended by the survey team.

(1) It is necessary to prevent river contamination and to protect fishery resources during the bridge construction work considering the environmental requirements. The construction schedule for the bridge section must be reflect these restrictions on river work from the environmental aspects as well as the navigation close in winter.

(2) It is recommended to adopt international tender for procurement of consultants and contractor(s) considering the lack of experience with suspension bridges among local consultants and contractors in Ukraine.

(3) Support by the consultant who carried out the preliminary design will be necessary for the local consultant who will be responsible to implement the feasibility study (project documentation) to get approval from the concerned Ministries, and after that, from the Cabinet of Ministers of Ukraine.