1. Basic Information
1.1 Désirée Number: PL01.08.14
1.2 Title: Modernisation of the National Road No 6 on section Goleniów – Nowogard from km 25+200 to km 40+195 (former chainage from km 30+425 to km 45+420)
   Stage II – Modernisation of section Bodzecin – Redostowo from km 29+800 to km 34+644
1.3 Sector: Infrastructure
1.4 Location:
   Republic of Poland. Zachodniopomorskie Voivodeship, District of Goleniów, average distance from Polish – German border; ca 45 km

2. Objectives
2.1 Strategic Objective:
   • Adjustment of road parameters to EU and NATO requirements in the way of pavement and bridges admissible bearing capacity and fulfilment of priorities defined in “Partnership for Membership” treaty.
   • Improvement of traffic safety, improvement of pavement quality, road capacity increase.

2.2 Direct Objective:
   • Road traffic conditions improvement;
     - pavement bearing capacity enhancement to 115 kN/axis
     - pavement width enlargement to 7.0+2*2.00,
     - traffic safety improvement
     - pavement quality improvement
     - road capacity increase
     - elimination of ecological threats by protecting fittings implementation

2.3 Accession Partnership and NPAA priority;
   AP policy priority
   NPAA policy priority
   Realisation of the National Program of Preparation to Poland Membership in EU provisions – Priority 9.2 – Polish Transportation Law and Standards adjustment continuation for expected requirements of Poland membership in EU, Task A-4 – Polish Law on transportation infrastructure adjustment to EU requirements.

2.4 Contribution to National Development Plan (NDP) and Joined Program Document (JPD) Phare CBC realisations;
   • NDP – Program realisation is coincident with development axis No 3 – Polish economy integration by transportation network modernisation and development
   • JPD – Main objective – Contribution for balanced and stable development and bringing citizens and institutions together in Polish – German neighbour provinces; Mecklenburgia and Brandenburgia lands and Zachodniopomorskie Voivodeship, Priority B – technical and tourist infrastructure improvement, enterprises group B-2 – activities for over regional and internal outfit improvement of Region’s transportation infrastructure (vehicles roads).
   • Realisation of Zachodniopomorskie Voivodeship development strategy assumptions in the way of transportation infrastructure development and modernisation, province transportation system integration with the EU and Baltic Sea region ones. (Chapter VIII Zachodniopomorskie Voivodeship Mission, Strategic aim – Common Accessibility of Goods, Services and Information, Priority 1 – Introducing of transportation network compatible with the ones of the neighbour regions and countries).

2.5 Cross Border Impact.
   • Transportation infrastructure improvement, development of trans-european transportation systems within;  
     - BALTIC BRIDGE program – program of Baltic co-operation,
     - Cross border co-operation program within POMERANIA EUROREGION
     - Program of over border co-operation with lands of Mecklenburgia and Brandenburgia.
The project is strictly related to the JPD priority: infrastructure and the measure concerning development of the integrated regional transport and communication networks.

3. Description
3.1 Background and justification:
- Pavement construction, its poor technical parameters (bearing capacity, width, radii of horizontal curvatures), and bad technical condition do not fulfil the current traffic requirements, nor meet EU and NATO standards. Inconsistent geometric parameters within whole managed section of the road (in further section from km 79+818 the road is equipped with harden shoulders) are another important factor urging to modernisation works undertaking.

3.2 Linked activities:
The Project is further stage of modernisation works submitted to Phare CBC Poland – Germany 2000 program. The section of the road Goleniów – Bodzecin has been accepted as the first stage. Project realisation has been accepted by Ministry of Transportation and Maritime Economy.

3.3 Project Results:
- The road section modernisation shall be the second stage of the National Road No 6 modernisation, so the road shall be adjusted to EU and NATO standards. The works completion shall also cause the road geometric parameters unification in the whole road section within Zachodniopomorskie Voivodeship, improve traffic safety, road conditions and driving comfort and shall make journey from Polish – German border to Koszalin and Gdansk more efficient.

3.4 Products/results:
Project implementation shall result in road modernisation to parameters consistent with EU requirements. The length of modernised section – 3.844 km, carriageways width – 7.0 m + hard shoulders 2*2.0 m. Vehicles of accepted bearing of 115 kN/axis shall be admitted to road traffic.

3.5 Activities:
For the task realisation, the modernisation works should be carried out according to prepared final technical project. The Contractor, chosen in tender procedure have to dispose a proper means necessary to road works performance, as specialist fittings and experienced staff.
The Contract provides the modernisation work execution.

Financial means of 2.0 MEUR as a Phare 2001 component and 3.6 MEUR of budget means are necessary for the works performance.

4. Institutional Framework
4.1 The Project after completion, shall be property of Beneficiary - General Directorate of Public Roads ,North – Western Division in Szczecin
In Project realisation the following institutions shall be engaged;
- Ministry of Transportation and Maritime Economy
- Marshall’s Office of Zachodniopomorskie Voivodeship
- Zachodniopomorskie Voivodeship Governor
- Implementing Authority of Phare Cross Border Co-operation Program

4.2 The Project result shall not cause any changes in described institutional structure.

4.3 Twinning projects – not concern.

4.4 “Engineer” - Representative of General Directorate of Public Roads, North – Western Division in Szczecin
“Resident Engineer” – shall be chosen in tender procedure
“Employer” - General Directorate of Public Roads, North - Western Division in Szczecin

Modernised section of the road will be the public property after Project completion.
Implementing agency is; Implementing Authority of Phare CBC in Home and Administration Ministry, Department of Cross Border Co-operation, Implementing Authority of Phare Cross Border Co-operation Program.
Tel. (+48-22) 695 99 10/11, fax . (+48-22) 69599 12/13 in Warsaw.

5. Budget: (M€)

<table>
<thead>
<tr>
<th>Phare Support CBC 2001</th>
<th>Investme</th>
<th>Institution</th>
<th>Total</th>
<th>National</th>
<th>IFI*</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>nt Support</td>
<td>Building Support</td>
<td>Phare CBC 2001</td>
<td>Co-financing*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------------</td>
<td>------------</td>
<td>------------------</td>
<td>---------------</td>
<td>--------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contract 1 (Stage I)</td>
<td>2.0</td>
<td>-</td>
<td>2.0</td>
<td>3.6</td>
<td>-</td>
<td>5.6</td>
</tr>
<tr>
<td>Total</td>
<td>2.0</td>
<td>-</td>
<td>2.0</td>
<td>3.6</td>
<td>-</td>
<td>5.6</td>
</tr>
</tbody>
</table>

Co-financing provided from national sources; 64 % from National Budget. Polish Authorities ensure, that public co-financing is accessible by budgetary reserve, annually foreseen by Ministry of Finance, as well as directly from budget of relevant Ministry.
Project has been approved by Ministry of Transportation and Maritime Economy.

6. Implementation Arrangements
Implementing Agency: The Implementing Authority for Phare Cross Border Co-operation Programme
Krucza 36 Street; 00-522 Warsaw
e-mail: Phare@wwpwp.it.pl

6.1 Twinning project
Not concern
6.3 Non-standard aspects
DIS Manual will be strictly followed.
6.4 Contracts
Contracts number – 1
Contract value (Stage II) - 5.6 MEUR

7. Implementation Schedule
7.1 Start of tendering; Ist quarter of 2002
7.2 Start of project activity: II-nd quarter of 2002
7.3 Project Completion: 31 December 2004

8. Equal Opportunity
Equal participation in project by women and men will be assured according to EOE (Equal Opportunity of Employment) standards of EU. In tendering procedure no sex nor religion will be taken into account. Project effects shall be shared for everybody.

9. Environment
In 1996 the full Report on environmental impact of modernised National Road No 6 on the section from km 30+425 to km 45+400 (currently from km 25+200 to km 40+195) was elaborated.
The most important environmental effects of the Project;
- the quality deterioration of rainfall water flow from road - the waste water purification set has been foreseen
- negative impact of exhausted gases for ambient air, soil and forest quality – area screens of insulation greens has been foreseen
- increased scope of noise annoyance – acoustic screens and insulation greens for the noise level reduction has been foreseen

10. Rates of return
Financial rate of return (FIRR) – has not been determined
Economical analyse of investment has been performed in accordance with Phare 2000 program.
Obtained internal rate of return (IRR) is 17,8 %.
Feasibility study has been completed – see Encl. No 3

11. Investment criteria
11.1 Catalytic effect:
Implementation program of roads modernisation for national roads adjustment to EU and NATO requirements covers 95% of Zachodniopomorskie Voivodeship road network. These works execution financing from only budget sources should significantly delete implementation possibility. The Phare
support will ease much faster priority actions performance, connected with Poland access to EU and will accelerate region economical development as well as will improve transit traffic conditions from Polish – German border.

11.2 Co-financing:
Project co-financing is anticipated from budget sources and possibly from MTD taxes.

11.3 Additionality:
Other financiers, especially from the private sector or IFI have not been excluded.

11.4 Project readiness and Size:
Projects is fully ready to contracting. There are final design, construction designs, land acquisition is completed, Permission for work is received.
Investment complies with minimum project size requirements; Contract value exceeds 2 MEUR, Polish side contribution is 46% for II Stage

11.5 Sustainability:
- The investment complies with EU norms and standards and is consistent with policy on transportation (European Council and Parliament Decision No 1692/96 of 23 July 1996 on EU Recommendation for Trans – European Transportation Network development and on TINA program – Evaluation of Infrastructure Needs in Transportation).
- Negative environmental impact of the investment shall be decreased by screens implementation.
- Administrative institution for modernised section of the road shall be General Directorate of Public Roads, North - Western Division in Szczecin. The means for maintenance and operating costs of the road shall be provided from national budget.

11.6 Compliance with state aids provisions
Project is consistent with state aid regulations for fulfilment of association treaty obligation. Investment has achieved approval of Ministry of Transportation and Maritime Economy, what means the state aid guarantee in project execution.

11.7 Contribution to National Development Plan and Joined Program Documentation;
- According to NDP - Program realisation is coincident with development axis No 3 – Polish economy integration by transportation network modernisation and development
- According to JPD Project assures of main objective realisation – Contribution for balanced and stable development and bringing citizens and institutions together in Polish – German neighbour provinces; Meclemburgia and Brandenburgia lands and Zachodniopomorskie Voivodship, Priority B – technical and tourist infrastructure improvement, enterprises group B-2 – activities for over regional and internal outfit improvement of Region’s transportation infrastructure (vehicles roads).
- According to Zachodniopomorskie Voivodeship development strategy (Chapter VIII Zachodniopomorskie Voivodeship Mission,) Project ensures realisation of Strategic aim – Common Accessibility of Goods, Services and Information, Priority 1 – Introducing of transportation network compatible with the ones of the neighbour regions and countries in the way of transportation infrastructure development and modernisation, Voivodeship transportation integration with the EU and Baltic Sea region ones.
- Project is part of the whole national and regional strategy of development, defined in the National Program of Poland Preparation to EU Membership in the way of Polish transportation system adjustment to European requirements within TINA.
- The Project also provides of Pomerania Euroregion common program implementation as well as programming document signed between Zachodniopomorskie Voivodeship and Meclemburgia and Brandenburgia lands authorities.

12. Conditionality and sequencing
General Directorate of Public Roads, North – Western Division in Szczecin as the project implementing institution is fully prepared to realisation of investment supported by Phare. It has the personnel trained in using FIDIC conditions and IFI requirements. There is the special Contracts Department in official Directorate structure, called for servicing of contracts financed by aid means.
- The investment commencement is possible with financial means procurement.
- The most important milestones of the project;
  - Project acceptance to PHARE program – II-nd half of the year 2001
  - Works commencement – II-nd quarter of 2002
  - Contract works completion – II-nd half of the year 2004
  - The last payments – maximal date of 31 December 2004
### Annex 1: LogFrame

<table>
<thead>
<tr>
<th>Date of drafting:</th>
<th>Planning period:</th>
<th>Total EUR;</th>
<th>Phare EUR;</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 November 2000</td>
<td>September 2001 - September 2003</td>
<td>5,6 MEUR</td>
<td>2,0 MEUR</td>
</tr>
</tbody>
</table>

**Modernisation of the National Road No 6 on section between Goleniów-Nowogard from km 25+200 to km 40+195 (former chainage from km 30+425 to km 45+420) Stage II Modernisation of the section Bodzecin – Redostowo from km 29+800 to km 34+644**

<table>
<thead>
<tr>
<th>Wider objective;</th>
<th>Indicators of Achievement;</th>
<th>Sources of information;</th>
<th>Assumptions and Risks;</th>
</tr>
</thead>
<tbody>
<tr>
<td>- adjustment of the road to EU and NATO parameters</td>
<td>- Poland membership to EU and economical and social development of the region</td>
<td>- GUC and GUS reports - data of transportation companies and institutions</td>
<td>- Poland’s consequent political involvement for European integration - realisation of Voivodeship development strategy provisions - realisation threats are not foreseen</td>
</tr>
<tr>
<td>- realisation of Poland and Zachodniopomorskie Voivodeship transportation strategy provisions</td>
<td>- road capacity increase - traffic accidents decrease - vehicles operation costs decrease - decreasing of exhausted gases and traffic noise harmful impacts to environment</td>
<td>- national and international statistics - road traffic investigations - Police statistics of traffic accidents - investigations of institutions involved in environment protection</td>
<td>- traffic volume increase - heavy traffic participation increase - realisation threats are not foreseen</td>
</tr>
</tbody>
</table>

**Immediate Objectives;**

<table>
<thead>
<tr>
<th>Indicators of Achievement;</th>
<th>Sources of information;</th>
<th>Assumptions and Risks</th>
</tr>
</thead>
<tbody>
<tr>
<td>- pavement bearing capacity enhancement and its geometric parameters improvement</td>
<td>- providing for vehicles traffic of EU standards on axis permissible load (115kN/axis) - providing for NATO vehicles traffic</td>
<td>- traffic volume increase - heavy traffic participation increase - realisation threats are not foreseen</td>
</tr>
<tr>
<td>- traffic safety improvement</td>
<td>- traffic measurements (annual and general every 5 years)</td>
<td></td>
</tr>
<tr>
<td>- ecological threats elimination</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Results/Outputs**

<table>
<thead>
<tr>
<th>Indicators of Achievement</th>
<th>Sources of information</th>
<th>Assumptions and Risks</th>
</tr>
</thead>
<tbody>
<tr>
<td>- EU and NATO requirements fulfilment in scope of;</td>
<td>- EU and NATO consultants reports - traffic measurements (annual and general every 5 years)</td>
<td>- traffic volume increase - heavy traffic participation increase - region economic development - realisation threats are not foreseen</td>
</tr>
<tr>
<td>- pavement bearing capacity improvement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- international traffic improvement</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Activities;**

<table>
<thead>
<tr>
<th>Indicators of Achievement</th>
<th>Sources of information</th>
<th>Assumptions and Risks</th>
</tr>
</thead>
<tbody>
<tr>
<td>- national budget and Phare means in accepted proportions</td>
<td>- decision making on financial means acceptance - high technical quality of performed works - commitment to operation</td>
<td>- Availability of the needed financial resources;</td>
</tr>
<tr>
<td>- high quality equipment to the road works</td>
<td>- laboratory tests during works performance</td>
<td>- Phare 2.0 MEUR - budget 3.6 MEUR</td>
</tr>
<tr>
<td>- highly qualified technical personnel</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Annex 2-4 Cumulative implementation, contracting and disbursement schedule

<table>
<thead>
<tr>
<th></th>
<th>I '02</th>
<th>II '02</th>
<th>III '02</th>
<th>IV '02</th>
<th>I '03</th>
<th>II '03</th>
<th>III '03</th>
<th>IV '03</th>
<th>I '04</th>
<th>II '04</th>
<th>III '04</th>
<th>IV '04</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Implementation schedule</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>C</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td></td>
</tr>
<tr>
<td><strong>Contracting schedule</strong></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td><strong>Disbursement schedule</strong></td>
<td>-</td>
<td>0.3</td>
<td>0.7</td>
<td>0.9</td>
<td>1</td>
<td>1.2</td>
<td>1.4</td>
<td>1.6</td>
<td>1.7</td>
<td>1.9</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

D = design of sub-projects / C = tendering and contracting / I = contract implementation and payment
Annex No 5

Reference to Project Feasibility;
Analyse of Project Feasibility;

<table>
<thead>
<tr>
<th>Description</th>
<th>Realisation date;</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Assessment of the Project influence on environment</td>
<td>Elaborated</td>
</tr>
<tr>
<td>2. Final designs with Approval documents, respecting recommendations of Assessment of the Project influence on environment</td>
<td>Elaborated</td>
</tr>
<tr>
<td>3. Tender documentation (acc. to FIDIC conditions)</td>
<td>To be completed to 30 June 2001</td>
</tr>
<tr>
<td>4. Land acquisition and Permission for Works</td>
<td>Elaborated</td>
</tr>
<tr>
<td>5. Tender announcement</td>
<td>Anticipated date; 1-st quarter of 2002</td>
</tr>
</tbody>
</table>

The Project realisation is conditioned by **Phare financial support procurement**. Necessary participation of Polish side is ensured by accpetation of Ministry of Transportation and Maritime Economy.

**EXPERT OF MINISTRY OF ENVIRONMENT PROTECTION, NATURAL RESOURCES AND FORESTRY IN ENVIRONMENT PROTECTION SUBJECT**

**PROAT Ltd**

**Contractor; Zakład Uslug Mostowych WIK in Gdansk**

**Title of Work; ASSESSMENT of National Road No 6 Modernisation on Natural Environment Road Section of Goleniów – Nowogard from km 30+425 to km 45+400**

No of work: **PS-29/96**


Leading Author; **Witold Kamiński M.Sc. Eng.**

**Szczecin January 1997**

**CONTENTS;**

1. Introduction 5
   1.1 Base of Work 5
   1.2 Subject of Assessment 5
   1.3 Purpose and Scope of Assessment 5
   1.4 List of Connected Law Acts, used Instructions and other Sources 5
2. Planned Investments 6
   2.1 Purpose and Scope of Investment 6
   2.2 Alignment of Analysed Route 6
   2.3 Design Assumptions and Initial Determinations for Modernised Road 7
   2.3.1 Description of Assumptions 7
   2.3.2 Realised Investment Data 7
   2.4 Investment Exploitation 8
3. Site Character of the Planned Investment Area 8
   3.1 Meteorological Conditions 8
   3.2 General Data of the Site 9
   3.3 Geological and Water Surrounding Character 10
   3.3.1 Main Geomorphology Features 10
   3.3.2 Surface Waters 11
   3.3.3 Geological Structure 11
   3.3.4 Hydro-geological Conditions 12
   3.4 Natural Environment Character 12
   3.4.1 Landscape 12
   3.4.2 Vegetation 12
   3.4.3 Fauna 14
3.4.4  Protected Areas and Elements  14
4.  Investment Influence on Environment - Threats Identification  15
4.1  Construction Works Influence  15
4.1.1  Scope of Influence on Ground and Water Surrounding  15
4.1.2  Influence on Natural Environment and Landscape  16
4.1.3  Influence of Contamination and Noise Emission  17
4.2  Threats from Road Exploitation  17
5.  Threats from Road Surface Contamination - Rainfall Flows  17
5.1  General Data  17
5.2  Character of Rainfall Flows from Analysed Road Section – Existing State and 2010 Year Anticipation  18
5.2.1  Scope of Analyse and Accepted Assumptions  18
5.2.2  Flows Intensity and Volume  19
5.2.3  Authoritative concentration and loads of Contamination  19
5.2.4  Rainfall Flows Quality Estimation and Conclusions  20
6.  Influence of Road Exploitation on Ambient Air Contamination  21
6.1  Introduction  21
6.2  Contamination’s Emission from Analysed Road Section  22
6.3  Methodology of Ambient Air Contamination Forecasting  24
6.4  Scope and Results of Ambient Air Contamination Calculations  25
6.5  Assessment and Conclusions  26
7.  Acoustic Climate Analysis  27
7.1  Purpose and Scope of Acoustic Analysis  27
7.2  General Character of Planned Investment Area  28
7.3  Description of National Road No 6 Considered Section  29
7.4  Permissible Levels of Noise  29
7.5  Investment Influence on Acoustic Climate Change  30
7.5.1  Noise Influence during Modernised Road Works  30
7.5.2  Traffic Noise Emission Anticipation Method  31
7.5.3  Current State and Forecasted Noise Level for 2010  31
7.6  Assessment and Conclusions  32
8.  Resume and Final Conclusions  34

Enclosures in Polish (Enclosures contents is included in Assessment data)
1.  Design Assumptions Given by Zaklad Uslug Mostowych WIK (designer) in Gdansk
2.  Excerpt from Spatial Arrangement Plan of Goleniów Commune for National Road No 6 on Section Goleniów – Nowogard
3.  Traffic General Measurement Data of 1995 with the List of Measurement Points
4.  Ambient Air Contamination Background in Modernised Road Area given by Sanitary Authorities.
5.1 – 5.2 Noise Levels Calculating Results and Data in Reference Point and Noise Influence Scopes

1.  INTRODUCTION
1.1  Base of work
   This Influence Assessment of Modernised National Road No 6 on Section Goleniów – Nowogard from km 30+425 to km 45+400 on Environment was elaborated on base of PS-39/96 Agreement concluded between Designer – Zaklad Uslug Mostowych WIK in Gdansk and “PROAT” Ltd in Szczecin.
   Legal base for elaborated “Influence Assessment...” is first of all;
   - Act of 7th July 1994 on Spatial Arrangement,
   - Decree of Minister of Environment Protection, Natural Resources and Forestry of 13th May 1995 on description of investment kinds harmful on environment and people health and on assessment of influence on environment.
1.2  Subject of Assessment
   The subject of Assessment is National Road No 6 Szczecin – Gdansk from km 30+425 to km 45+400, on section Goleniów – Nowogard during modernisation works as well as exploitation period (current and anticipated state).
1.3 Purpose and Scope of Assessment

The Purpose of “Assessment...” is to determine Environment conditions for modernisation works and further exploitation of considered section of the road, required for “determination of building and site arrangement conditions” according to Act of 7.07.1994 on Spatial Arrangement.

Scope of work covers essential elements for the assessment subject, among required by Decree of 13th May 1995 for the investments possibly harmful to environment.

This elaboration presents:
- general data on planned investment
- site characteristic in area of investment location, taking into account different elements like ground, surface and underground waters, vegetation, landscape...
- analysis of threats caused by road influence; modernisation works (area occupation), exhausted gases and noise emission and contamination from road surface; identification of collisions with environment and possibilities of their limitation,
- resume and final conclusions.

1.4 List of Connected Law Acts, used Instructions, and other Sources.

See Polish Version in original.

2. PLANNED INVESTMENTS

2.1 Purpose and Scope of Investment.

Reconstruction of the National Road No 6 Goleniów – Nowogard on the section from km 30+425 to km 45+400 consists in pavement widening and reinforcement, modernisation and construction of bridges on Gowienica and Stepnica Rivers, and is planned to get improvement of traffic fluency and security.

These purposes are given in determinations of “Spatial Arrangement Plans of Goleniów, Osina and Nowogard Communes [Encl.2].

Final Design of works is prepared by Zaklad Uslug Mostowych WIK in Gdansk, according to assumptions given by Regional Directory of Public Roads in Szczecin [Encl.1].

2.2 Alignment of Analysed Route

National Road No 6 on section Goleniów - Nowogard is one carriageway road of III technical class, 7m pavement width and is running through Goleniów, Osina and Nowogard communes area.

Analysed road section is crossing some villages as well as some natural space units (landscape elements). Forest ecosystems dominate along the whole section of the road, and in minor scale there are greens areas (meadows and pastures), barrens and cultivated areas. The road is crossing two river valleys.

One of them, it is Gowienica River valley, ca 1 km eastbound of Glewice village. The second one is Pilesza River valley, westbound of Kikorze village. The remaining parts may be divided for western part, running mainly through sand soils (from beginning of the section to Pilesza River) and eastern part, running through moraine plain area, of mainly clayey soils (from Pilesza valley to Olchów).

In the road area some dwelling buildings may be locally met. In Glevice village, ca km 33+500, housekeeping buildings are located in northern side of the road, 10 –15 m distant (one building just at the road side, ca 1-2 m distant). On the road southern side the Joiner’s Shop and a little further dwelling buildings (in distance of 15 – 20 m from the road) are located.

Km 39 + 600 – exit to Radostowo. The nearest dwelling buildings are located in distance of 250 – 300 m from the road.

Km 40 + 800 – Kikorze village. On the southern and northern side of the road some solitude dwelling buildings are located in distance of 40 – 70 m. Further, on southern side dwelling buildings are located in bigger distance, ca 120 – 150 m. Behind the exit to Osina village, km 42+800, there are two dwelling buildings in distance of 10 – 15 m from the road.

Km 44+400 - Filling Station.

Km 44+450 – single dwelling buildings of Olechowo settlement. These buildings are located on northern and southern side of the road, in distance of 15 – 30 m from the road along the section of ca 300 – 500 m.

At the entrance to Olechowo (the beginning of planned by-pass of Nowogard town), there are single dwelling buildings in distance of 50 – 80 m from the road (from km 45 + 500).

Drawing No 2.1 – Location of Modernised Road No 6 Goleniów – Nowogard on section from km 30+42 to km 45+400

Poczatek Modernizacji – Beginning of Modernised Section
Koniec Modernizacji – End of Modernised Section
2.3 Design Assumptions and Initial Determinations for Modernised Road
2.3.1 Description of Assumptions.
Elaborated Final Design of works covers modernisation of existing road to parameters of Express Road. The basic design parameters are as follow;
- design speed 100 km/h
- carriageway width 7 m
- hardened shoulders width 2 x 20 m
- soil shoulders width 2 x 0.75 m
  (in places of safety barriers location the soil shoulders width is 1.25 m)
To get these parameters the following works should be done;
- strengthening and restoration of existing pavement
- hardened shoulders construction
- road alignment correction in Kikorze village
- bridge construction in Kikorze village
- bridge reconstruction in Glewice village
- culverts reconstruction
-reconstruction of infrastructure facilities, being in collision with modernised road
The existing pavement is to be widened on following sections;
- from km 30+425 to km 33+000 symmetrical widening in both sides for 2,0m
- from km 33+000 to km 34+500 widening in right side
- from km 34+500 to km 35+500 symmetrical widening, in horizontal curves to curve inside
- from km 35+500 to km 39+000 widening in right side, on curves as above
- from km 39+000 to km 40+600 widening in left side, and in km39+800 to km 40+400 (within existing bridges) new bridges elements construction,
- from km 40+600 to km 45+400 symmetrical widening, on curves as above.

2.3.2 Realised Investment Data.
1. Basic equipment and working fittings;
   - bulldozers (100 KM), excavators 0.6 m³ for earthworks (ca 40 000 m³)
   - graders, static and vibratory rollers, bituminous mixture and subbase paving machines
   - asphalt concrete producing machine, located outside the road works area
2. Basic materials consumption;
   - subbase of natural aggregate improved with cement, ca 720 000 m²
     (14 400 m³).
   - asphalt concrete ca 56 000 tons
   - reinforced concrete prefabricated elements for bridge constructions
     (produced outside the road works).
3. Refuse;
   - materials from culverts demolition, ca 30 m³, set apart to refuse dump
   - existing bituminous pavement demolition – ca 50 m³ (for reusing in roads of lower class)
4. Investment realisation is foreseen in years 1998 – 1999

2.4 Investment Exploitation
Exploitation of the road after modernisation will be more advantageous to traffic safety and fluency, but will not have bigger influence on vehicles volume and structure composition, which are conditioned by different external factors.
For this "Assessment .. " needs, the general traffic volume and structure prognosis is given below, elaborated on the base of General Traffic Measurement 1995 results [Encl.3];
Average daily traffic [veh/day] on the road Golębiów – Nowogard from km 30+425 to km 45+400. (Measurement point No 4103069)
Traffic increase index was accepted according to European Bank of Reconstruction and Development recommendations, which assume in the first period (years 1995 – 2000) 6% of traffic annual increase, and later 1% decrease of the index value in every 5 years periods. Night traffic participation (hours 22 – 6 ) is estimated for 10% of full daily traffic (in analogy to other roads data used in Assessments elaborated by “PROAT”).

3. SITE CHARACTER OF THE PLANNED INVESTMENT AREA

3.1 Meteorological Conditions

Climate and meteorological conditions play an essential role in environment protection questions connected with road exploitation. Winds, balance of atmosphere, ambient air temperature have a big impact on exhausted gases spreading in the air, and rainfalls decide on concentration and value of contamination flow from road pavement.

These conditions are characterised on the base of the meteorological station data nearest to the planned investment, in this case of Resko and Goleniów.

According to Resko meteorological station data, the southern–west bound winds are dominant, the western ones appear in 38,1% cases. The northern winds are the least appearance – 3,83%.

The winds participation in particular scopes of speed is as follow:
- 0 – 2 m/s 62,7%
- 3 – 4 m/s 25,3%
- over 5 m/s 12 %

The participation of particular balance state in every wind speeds ranges are as follow;
- State 1 and 2 very unsteady balance A and unsteady balance B 12,2%
- State 3 light unsteady balance C 22,7%
- State 4 neutral balance D 44,3%
- State 5 and 6 stable balance E and outstanding stable balance F 20,8%

Ambient air temperature and atmosphere falls

<table>
<thead>
<tr>
<th>Average air temperature [°C]*</th>
<th>Year Average</th>
<th>Winter</th>
<th>Spring</th>
<th>Summer</th>
<th>Autumn</th>
<th>Month average</th>
</tr>
</thead>
<tbody>
<tr>
<td>RESKO</td>
<td>7,6</td>
<td>-0,6</td>
<td>6,3</td>
<td>16,4</td>
<td>8,2</td>
<td>Min-2,2</td>
</tr>
</tbody>
</table>

*) Data PIHM acc. to Climatic Map of Poland

Ambient air temperature and atmosphere falls

<table>
<thead>
<tr>
<th>Station</th>
<th>Months</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I</td>
<td>II</td>
</tr>
<tr>
<td>Goleniów</td>
<td>41</td>
<td>37</td>
</tr>
</tbody>
</table>

In area of planned investment the atmosphere falls volume is lower than country average [600 – 750 mm]

3.2 General Data of the Site.

The road No 6 from km 30+425 to km 45+400, foreseen for modernisation and partly (especially in river valleys) for reconstruction is running in generally even terrain on 30 – 31 m over the see level in esker plains and river valleys, to 57 – 59 m over the see levels in moraine areas.

The road is running through different morphology units, which basic limitations are given on the map in scale 1:50 000 (Draw. No 3.1). Generally there are:
- Sandy esker plains and Pleistocene terraces in western parts
- Gowienica River valley
- central mixed area with significant participation of terraces plains (also with dunes)
- Stepnica River valley
- eastern moraine area in Kikorze and Olchów vicinity, limited from the south by Pilesza River valley

Every of listed above morphology units have its characteristic features of surface character as well as subbase construction.

There are no local bigger terrain height changes in the road profile, except of rivers valleys. Generally, there is also lack of bigger earth embankments and cuttings and some ones are on very short sections (50 to 70 m) and their height difference is rarely bigger than 2.5 m.

The considered terrain features, except of valleys, will not cause a big earthworks during road modernisation, especially at road carriageway widening. In most cases it will be a small corrections, practically in existing terrain level.

In valleys, with Pilesza River valley except, the earthworks and constructions work scope will be significant. It is connected with the road axis shifting in respect to existing one, and necessity of new embankments forming and construction or reconstruction of the bridges. The embankment height can reach up to 4 m there.

### 3.3. Geological and Water Surrounding Character.

#### 3.3.1 Main Geomorphology Features.

The general area division for geological and morphological units is shown in the basic map [draw. No 3.1]. In the western part, i.e. in Glewice area, the ground heights are rather even, and covered in range of 32 – 35 m. The terrain is gradually raising in eastern bound up to Gowienica River valley. Lower parts are wavy, and terrain heights are rising up to 45 – 47 m over the see level. Further in east bound, beyond Stepnica River valley, the ground levels are even higher, up to 59 m in Olchów area.

Despite these differences, except the valleys, longitudinal gradients of the road are small and does not exceed 5 – 6%. The bigger gradients appear in valleys boundaries only. The road is running by Pilesza River valley only by its edge, not going inside, so there are not changes in profile and in subbase structure as in other valleys.

The characteristic feature of terrace plains is low dune hills appearance. They are fully forested, so are not distinguished in the site. In their area some interdune hollows are met with generally shallow ground water levels. These hollows are specially numerous in road section from km 37+000 to km 38+400

**Drawing No 3.1 – Morphology division**

Omawiany odcinek drogi – Considered road section
1. Dolina rzeki Gowienicy – Gowienica River valley
2. Dolina rzeki Stepnicy – Stepnica River valley
3. Dolina rzeki Pileszy – Pilesza River valley
4. Równiny zandrowe i tarasowe – Esker and terrace plains
5. Równiny morenowe – Moraine plains

#### 3.3.2 Surface waters

The basic system is formed by Gowienica, Stepnica and Pilesza Rivers. Beside these rivers, there is open ditches and local streams system, especially in the middle part of the route. All these streams run water to above mentioned rivers.

Water levels in the rivers change in the range of 1 m. Generally there are not observed valley flood, even at high water levels. The flood water were met only at extremely high water levels, so called century waters. The rivers have partly regulated beds, and in Stepnica River valley, below the bridges location, the retention reservoir was erected in 70 –ties. Also some pale works has been done there, but not used for any construction.

The forest areas between Gowienica River valley and Redostowo village are relatively poorly drained. There are local water spots near the some parts of the road. This section of the road from km 36+000 to km 38+400 need roads ditches and dewatering system careful shaping.

Local culverts of the road, very few after all, shall need extension only due to anticipated road widening. There are 6 such culverts in considered section of the road.

#### 3.3.3 Geological structure.

Geological structure of the whole road section is known from geological maps as well as from direct investigations on the site. Investigations were carried out in rivers valleys and in some sections beyond the valleys in connection with earlier anticipated reconstruction of the road and construction of new bridges.
The basic features of geological structure are shown on map in scale 1:25 000 [draw. No 3.2], covering road and adjacent area. This sketch was prepared on base of old geological map in scale 1:25 000.

On the sketch there are shown sections of subbase consisted of sand and covered by clear humus layer, rivers valleys and sections running through clayey moraine terrain. Such characteristic is sufficient for this elaboration needs, but for design purposes, detailed investigations are needed along all the road sections, with determination of subsoil structure, its geotechnical feature and ground water conditions.

According to designer information such investigations has been started and shall be continued.

Within esker plains and Pleistocene accumulative terraces, the subsoil is sandy. In surface layers (to 2-3 m below the ground level) there are usually fine sands or fine and middle sands. In deeper layers there are also coarse sands and sand-gravel mix.

Within moraine plains, there are mainly clayey sands and clays in miner extend. In this area rarely occur also fine sand layers with gravel. The layers thickness rarely exceeds 1,5 m.

In Gowienica River valley, wide here for 265 m, there are organic soils of layer thickness up to 6 m. There are mainly peats, but also muds and gyttias.

In Stepnica River valley, wide here for 260 m, there are also organic soils, first of all peats of up to 7 m thick layer. In the middle part of valley there are islands of sandy soils, dividing valley to two parts.

In Pilesza River valley, in its extreme part which the road is running on, there are sands only. Humus soils occur in more distant parts of the valley

**Drawing No 3.2 – Geological structure**

Omawiany odcinek drogi – Considered road section

1. Piaski gliniaste i gliny – Clayey sands and clays
2. Pokrywy piaszczyste na glinach – Sandy covers on clays
3. Piaski zandrowe i piaski tarasów akumulacyjnych (także piaski wydmowe) – Esker sands and accumulative terraces sands (also dune sands)
4. Pokrywy humusowe na piaskach – Humus covers on sands
5. Torfy i namuly w dolinach rzecznych – Peats and muds in river valleys

3.3.4 Hydro-geological conditions.

Shallow ground waters occurs in sandy plains areas. The water level is mainly up to 1,5 m below ground level. Some parts of area, which was mentioned above [p.3.3.1] have the very shallow ground water, in some places water pools making. Such sections occur between Glecwice village and Gowienica River valley and in middle part of the road (km 37+000 to km 38+400). Shallow ground water is also met in rivers valleys.

In high levelled part of the road the shallow ground water occurs sporadically, mainly as dribbling water in layers of clayey sands.

Deeper underground waters occur in this area in different configurations. Usually there are two water-bearing layers in depth of up to 80 m. Hydrological conditions are not uniformed here, and moreover bigger water-bearing structures are not stated here. The nearby located villages of Bozecin, Kosciuszki and Kikorze use water from water-bearing layers of 30 – 40 m below the ground level.

Planned road works do not reach the depth of used water-bearing layers. Anyway, the works should take into account the shallow ground water appearance, especially in places where water level is practically the same as the ground level.

3.4 Natural Environment Character

3.4.1 Landscape.

The occurring along the discussed section of the road No 6 landscape is differentiated. Substantially, there are few kinds of landscape, different with natural and spatial features. Anyway, two types of landscape are dominant; seminatural and agriculture ones, making together a group of culture landscapes.

3.4.2 Vegetation (draw. No 3.4)

Vegetation occurring along the discussed section of the road is differentiated. There are forest complexes, road along trees and bushes, and also areas without trees and bushes, covered by greens, most frequently neighbouring to agriculture areas and barrens.

Herb greens.
Herb greens is growing on road shoulders, slopes, green areas, barrens and edges of agriculture fields. The dominant collections consist of synanthropic species, and among them collections of perennials, belonged to *Artemisietea* class, ruderal collections consisted of teorofits *Chenopodietea*. In some places there are also greens collections characteristic to periodically wet meadows, classified as *Molinio – Arrhenatheretea*.

On the considered area the following plant species has been found; Grasses – *Graminae*;

- *Phalaris aruninacea*
- *Anthoxanthum odoratum*
- *Phleum pratense*
- *Agrostis alba*
- *Deschampsia caespitosa*

- *Polygonaceae*;
  - *Rumex acetosa*
  - *Rumex crispus*

- *Carophyllaceae*;
  - *Stellaria media*
  - *Silene alba*

- *Ranunculaceae*;
  - *Ranunculus acer*

- *Ubelliferae*;
  - *Pimpinella saxifraga*
  - *Daucus carota*
  - *Heracleum sphondylium*

- *Plantaginaceae*;
  - *Plantago major*

- *Compositae*;
  - *Achillea millefolium*
  - *Centaurea jacea*
  - *Leontodon autumnalis*
  - *Artemisia vulgaris*

- *Cruciferae*;
  - *Capsella bursa-pastoris*

- *Urticaceae*;
  - *Urtica dioica*

**Trees and bushes greens.**

Along some road sections there are forest complexes as well as typical roadside trees.

Existing forest complexes belong to mixed type forests. There are pine and oak forests, consisted of common pines (*Pinus silvestris*) and oaks (*Quercus sp.*). Alloy species are; birch (*Betula verrucosa*), common beech (*Fagus sylvatica*), and common spruce (*Picea abies*).

Roadside tress consist mainly of; maples (*Acer sp.*), lindens (*Tilia sp.*), ashes (*Fraxinus excelsior*) and birches.

### 3.4.3 Fauna

Direct road surrounding does not create convenient conditions for animals existence and settlement, especially for vertebrates. The birds are the most observed fauna representatives during whole year time, especially in human settlements vicinity and in agriculture areas.

The most frequently met birds species are;
Passerines – Passeriformes:
- Magpie - *Pica pica* – class preserved from 15 March to 30 June
- Fieldfare - *Turdus pilaris* - class preserved
- Greater titmouse - *Parus major* - class preserved
- Starling - *Sturnus vulgaris* - class preserved
- Sparrow - *Passer domesticus* - class preserved
- Rook - *Corvus frugilegus* - class preserved from 15 March to 30 June
- Jackdaw - *Corvus monedula* - class preserved
- Chatfinch - *Fringilla coelebs* - class preserved

### 3.4.4 Protected Areas and Elements

On the base of Minister of Environment Protection, Natural Resources and Forestry Decree of 6 January 1995 on Animals Species Preservation (Dz.U. of 16 February 1995 No 13 pos.61) the preserved species of animals are listed in fauna description.

On the base of Minister of Environment Protection, Natural Resources and Forestry Decree of 6 April 1995 on Vegetation Species Preservation (Dz.U. of 18 April 1995 No 41 pos. 214) on the area covered by this elaboration, the preserved species of vegetation has not been found.

### 4. INVESTMENT INFLUENCE ON ENVIRONMENT - THREATS IDENTIFICATION

#### 4.1. Construction Works Influence

##### 4.1.1. Scope of Influence on Ground and Water Surrounding

In earthworks scope there are road formation widening to the width at least 12.5 m. On straight road sections both sides widening does not need significant earthworks, because the road is running mostly on low embankment.

The bigger scope of earthworks (embankments) will be in horizontal curves, where widening will be one sided toward inner side of the curves. In rivers valleys the embankment shall need shaping on the whole height and partly on the new alignment.

According to design data, total scope of the earthworks shall consist of 40 000 m$^3$. The more detailed analysis made for this elaboration needs shows that ca 20% of necessary soil volume (ca 8 000 m$^3$) may be obtained from local cuts, i.e. from cuts made for road alignment shaping. The remaining volume must be supplied from other sources. The places of supply will be determined later.

Possibility of sands and gravel taking according to local reconnaissance is possible only in the middle part of the road area, north bound from Kikorze village and in Osina village area, on Pilesza River valley slopes. In remaining parts of the road there are not such possibilities. The nearest big natural aggregate pits exist in Mosty and Podansko villages area, east bound of Goleniów.

Embarkment shaping in flat sections of the road is not an essential problem due to their small height, ca 1.0 to 1.5 m and also plain adjacent terrain. Such situation occurs from beginning of the road (km 30+425), through Glewice village to Gowienica River and further to km 38+500. In this section, due to low levelled and watered ground, the embankments should be a little higher. The lack of higher embankments is observed also in even sections on moraine areas.

The bigger scope of earthworks, with soil acquisition occurs first of all in transition zones from sandy plains to higher moraine area.

The embankment shaping in rivers valleys on a weak organic subsoil may be an essential problem. The embankments here should be made gradually and in advance to avoid organic soils displacement and to assure their uniform settlement. The advance period should be at least one year before the final shaping of new road body.

Construction structures consists of; bridge widening over Gowienica River and new bridge (bridges) over Stepnica River. The abutments of one span bridges will need foundation on piles. Probably driven prefabricated piles or big diameters piles will be accepted. Due to environment aspects, the first one as well as the second one solution may be considered.
It is also desired, that all dispensable parts of old structures should be demolished and removed. It does not concern of the old road parts, which can be used for roadside parking purposes.

Existing culverts extension will be executed in good soil conditions, usually in sands and probably will not cause bigger technical problems. Anyway, in some places, probably temporary dewatering systems will be necessary during construction works. The local ground water level depression of ca 0.5 – 0.7 m may be obtained by direct water pumping from the cutting.

The bigger cuts will need sheet piling or full shuttering application. In culverts area there are not any other constructions possibly threatened by planned works realisation.

Other requirements concern removal and reusing of the humus layers from shoulders and ditches, where additional embankments shall be formed. All humus layer in these areas must be removed, stored and used for fresh embankments covering.

On forest areas of sandy subsoil, the humus layer thickness is relatively small (15 – 20 cm). The bigger humus layer thickness occurs in depression areas, where it may reach even 50 – 60 cm. It concerns the section of eastern and western sides of Glewice village (km 32 to km 34), middle part from km 37 to km 38 and the 500 m long section on the south side of the road in Plesza River valley (km 43).

For works surface arrangement the peat soils, from rivers valleys, should be also exploited.

4.1.2 Influence on Natural Environment and Landscape.

The National Road No 6 modernisation will cause following changes in existing natural environment;
- cutting of necessary trees and bushes currently growing in direct vicinity of some parts of the road
- in some sections going through the forest area, due to trees and bushes cutting, the forest boundary will be open in some places (it is just already made)
- partial or complete demolition of greens complexes in terrain belts foreseen for their occupation and in their vicinity
- modification of greens settlements in some sections of modernised road, due to construction work performance and new arrangement of the site

Influence to fauna.

There is direct and indirect influence to animals world. It should be marked anyway, that due to road modernisation works (only existing pavement widening), this influence will be rather small. The soil fauna, living in direct and close surrounding of the road will be in significant extent demolished on the sections destined to modernisation.

Some numbers of amphibians and reptiles may be killed, especially in case of works provided in direct vicinity of their settlements, attractive for living of fauna units; for example; streams, water reservoirs, watered areas, green areas or barrens. Such places along the road rout are anyway very rare.

Influence on mammals and birds will be rather indirect. Currently in many sections of the road, greens is removed from modernisation works terrain corridors, so probably the new interference in greens or in animals settlements shall not be necessary. The influence of modernised road on mammals or birds shall be connected rather with different kind of antropogenic disturbances, caused by construction works and further traffic on the road.

The discussed investment influence on existing landscape shall be perishable. Due to small intervention scale on environment, its degradation, or its natural components degradation will not be observed in any of the modernised road section.

It is presumed, that later traffic operation on the road will not negatively affect on the health state of greens growing in the road area. The negative impact will not be either observed on animals world. As mentioned above, existing route of the road will not be changed, so previous settlements and migration paths of animals will not be violated.

4.1.3 Influence of Contamination and Noise Emission

Negative influence of construction period on environment results mainly from occupation of the site, previously used for other function. The ambient air contamination and noise emissions have fewer significance, mainly due to temporary character of works. Anyway, these
annoyances should be limited as much as possible by proper equipment and fitting using, proper way of works and management.

In construction period the following air contamination shall be emitted;
- toxic and non-toxic mineral dust from loose materials relocation (earthworks)
- exhausted gases from working machines and transportation means
- gases (odours) from heated bituminous materials during pavement works

These emissions make not essential threat for environment. For example in case of pavement works from bituminous mix, the average emission is estimated as follow [1.4.30];

<table>
<thead>
<tr>
<th>Emission for 1 ton of bituminous and mineral mix</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aliphatic hydrocarbons</td>
</tr>
<tr>
<td>Sulfuretted hydrogen</td>
</tr>
<tr>
<td>Merkaptans</td>
</tr>
</tbody>
</table>

The noise influence on acoustic climate is considered in point 7.

4.2 Threats from Road Exploitation.

Road exploitation is connected with essential threats for environment, caused by exhausted gases and traffic noise emissions, and contamination from road surface. Contamination from road surface usually flow with atmospheric falls.

The scale of mentioned above threats, discussed in detail in points 5,6 and 7 depends on traffic volume, vehicles structure and character of environment receptors.

Traffic volume and vehicles structure is assumed on the base of Traffic Prognosis ...

5. Threats from Road Surface Contamination – Rainfall Flows

5.1 General Data.

Roads exploitation is connected with following contamination of their surface;
- contamination falling with vehicles exhausted gases
- tyres and pavement abrading and vehicles element tearing products
- loose and liquid materials improper transportation
- chemicals used to pavement slippery fighting
- materials used for road construction and washed out with atmospheric falls
- chemicals, dangerous included, flooding during traffic accidents

These contamination is washed out by rain falls and thaw. Falls flows from the road have character of sewage, especially essential after longer dry weather period, due to contamination accumulation on the road surface and in snow gathered on shoulders.

The main indexes of rainfall flows contamination are;
- suspensions
- heavy metals and other toxic substances
- biogenic compounds (nitrogen and phosphor)
- chlorines
- organic and non-organic compounds, determined by complete and organic coal contents and ChZT contents
- oil originated substances, including aromatic hydrocarbons

The biggest contamination concentration in sewage flows is in the first period of the flowing and significantly depends on fall characteristic (intensity, duration, dry weather lasting), kind of road and road surroundings. In further time of flowing, there is distinct decrease of contamination concentration.

The most essential threats for ground water receiving flows from road surface are common suspensions, ChZT and connected with them heavy metals compounds, because value of these indicators generally exceeds acceptable standards. The dangerous source of water contamination are thaw flows, especially from snow after storing in longer period on road shoulders.

Thaw flows contamination is close in features to rain flows contamination, except chlorine concentrations, and polyclic aromatic hydrocarbons (WWA). Big chlorine concentrations are caused by pavement salting, and WWA in winter conditions are not treated with intensive disintegration process as in summer time.

The oil and grease substances (treated by ether), as well as sludge, connected with heavy metals (mainly lead) as in case of common suspension are also the threats for environment.
Heavy metals introducing into environment is specially dangerous due to their durability, because they are not subject of bio-degradation processes, so they may be cumulated even in small loads and periodically added.

Environment contamination by lead from ethylene combustion is currently decreasing due to introducing new cars using lead free gasoline. From the year of 2000 this contamination practically should not be met due to foreseen prohibition of lead compound emission from vehicles engines. [1.4.16, 1.4.17].

In connection with above, the lead compounds in falls flows from the planned road investment may be treated as inessential and omitted.

5.2 Character of Rainfall Flows from Analysed Road Section – Existing State and 2010 Year Anticipation.

5.2.1 Scope of Analyse and Accepted Assumptions.

Falls flow was characterised by GDPR materials using [1.4.26]. In the analyse procedure, the flows concentrations and quantity as well as similar contamination parameters on considered road section in current state (1995) and for anticipated year of 2010 are determined.

Assumptions accepted;
1. Tight surface of pavement on designed section of the road are calculated on the base of data given in Chapter 2
   a) existing state – 10.46 ha
   b) designed state – 16.47 ha
2. Annual atmospheric falls value – 580 mm (p.3.1)
3. Traffic volume according to Traffic Prognosis... (p.2.4)

Denotations used;
- Q [m$^3$/s] - Volume of falls flow from tight surface of road
- V [m$^3$/year] - Annual volume of falls flow from the road
- S [m$^3$/s] - Contamination concentration
- L rocz. [kg/year] - Annual loads
- L ch [g/s] - Momentary loads
- A [ha] - Tight surface of road
- H [mm/year] - annual atmospheric falls volume
- q m - unitary flow concentration = 5l/s ha, determined on IOS of Warsaw investigations

5.2.2 Flows Intensity and Volume

<table>
<thead>
<tr>
<th>Specification</th>
<th>Calculation</th>
<th>Existing state</th>
<th>Prognosis of 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q [m$^3$/s]</td>
<td>Q = q m x A x 10$^{-3}$</td>
<td>0.0524</td>
<td>0.0823</td>
</tr>
<tr>
<td>V [m$^3$/year]</td>
<td>V = 8.1 x H x A</td>
<td>49188</td>
<td>77376</td>
</tr>
</tbody>
</table>

5.2.3 Authoritative Concentration and Loads of Contamination

The basic index for contamination of falls flow is common suspensions, because, as many investigations show, the remaining kinds of essential contamination are connected with them – their concentration level is directly or indirectly function of suspensions concentration [1.4.26].

Suspension concentration in falls flow in conditions of common road exploitation depends on vehicles traffic volume

Authoritative suspension concentrations are determined on the base of 4 lanes road (4 x 3.5 m), showed on Drawing No 5.1

Drawing No 5.1 Suspension concentrations dependence on traffic volume.

For fewer numbers of traffic lanes, the following formula is used;

\[ S_{\text{in}} = 0.8 \times S \times 4/n; \]

where \( n \) – number of traffic lanes 3.5 m wide

Contamination concentrations in falls flow calculated according to given rules for current state and prognosis for 2010 year are shown in Table 5.1
Table 5.1 Concentration of contamination indexes \([\text{g/m}^3]\) in falls flow

<table>
<thead>
<tr>
<th>No</th>
<th>Index</th>
<th>Concentration – units value</th>
<th>Permissible values of indexes*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Current state</td>
<td>2010 Prognosis</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Common suspension</td>
<td>280</td>
<td>205</td>
</tr>
<tr>
<td>2</td>
<td>ChZT</td>
<td>337</td>
<td>254</td>
</tr>
<tr>
<td>3</td>
<td>BZT_s</td>
<td>67,4</td>
<td>50,8</td>
</tr>
<tr>
<td>4</td>
<td>Oils and grease (E)</td>
<td>22,4</td>
<td>16,4</td>
</tr>
<tr>
<td>5</td>
<td>General nitrogen (N)</td>
<td>8,4</td>
<td>6,1</td>
</tr>
<tr>
<td>6</td>
<td>Benzo-a-piren (BaP)</td>
<td>(0.47 \times 10^{-3})</td>
<td>(0.35 \times 10^{-3})</td>
</tr>
<tr>
<td>7</td>
<td>Aromatic hydrocarbons (WWA)</td>
<td>(3.7 \times 10^{-3})</td>
<td>(2.8 \times 10^{-3})</td>
</tr>
<tr>
<td>8</td>
<td>Lead</td>
<td>0.164</td>
<td>-</td>
</tr>
</tbody>
</table>

* Acc. Ministry Decree on conditions of sewage introduced to water or to the ground [1.4.9]

Contamination loads in fall flows from roads, annual and momentary, are determined according to following formulas:

\[
L_{roc} = S \times V \times 10^{-3} \\
L_{ch} = S \times Q
\]

Anticipated contamination loads in fall flows from the planned road investment are given in table 5.2

Table 5.2 Contamination loads in fall flows;

<table>
<thead>
<tr>
<th>No</th>
<th>Flows contamination Index</th>
<th>Current state</th>
<th>2010 Prognosis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Kg/year</td>
<td>G/s</td>
<td>Kg/year</td>
</tr>
<tr>
<td>1</td>
<td>Common suspension</td>
<td>13 773</td>
<td>14.6</td>
</tr>
<tr>
<td>2</td>
<td>ChZT</td>
<td>16 576</td>
<td>17.6</td>
</tr>
<tr>
<td>3</td>
<td>BZT_s</td>
<td>3 315</td>
<td>3.5</td>
</tr>
<tr>
<td>4</td>
<td>Oils and grease (E)</td>
<td>1 102</td>
<td>1.2</td>
</tr>
<tr>
<td>5</td>
<td>General nitrogen (N)</td>
<td>413.2</td>
<td>0.4</td>
</tr>
<tr>
<td>6</td>
<td>Benzo-a-piren (BaP)</td>
<td>0.182</td>
<td>(0.19 \times 10^{-3})</td>
</tr>
<tr>
<td>7</td>
<td>Aromatic hydrocarbons (WWA)</td>
<td>0.023</td>
<td>(0.24 \times 10^{-4})</td>
</tr>
<tr>
<td>8</td>
<td>Lead</td>
<td>8.07</td>
<td>0.008</td>
</tr>
</tbody>
</table>

5.2.4 Rainfall Flows Quality Estimation and Conclusions.

The conclusions from data given in tables 5.1 and 5.2, characterising fall flows in current state and 2010 prognosis are as follow:

1) Concentrations of some contamination in flows are higher than permissible their indexes [1.4.9]. It concern; common suspension, ChZT and BZT_s.

2) In prognosis for 2010, the contamination load is bigger for ca 15%, what is caused from bigger traffic volume, independent on planned investment. Planned investment completion will be advantageous for flows quality improvement – contamination concentrations in fall flows will decrease.

Fall water from carriageway, should be directed according to pavement slopes to road ditches, which should be performed by taking the conditions of point 4.1.1 into account.

6. INFLUENCE OF ROAD EXPLOITATION ON AMBIENT AIR CONTAMINATION.

6.1. Introduction.

In global contamination emission from macro area sources, emission from transportation means has more and more bigger part. This fact indicate an urgent need of contamination emission decreasing from these sources, what mainly concerns vehicles with fuel engines.

Contamination emission by fuel engine vehicles is limited by introducing new types of cars using fuel without lead and equipped with catalisators. Those elements progressively introduced in Poland shall significantly change the contamination emissions level from vehicles, but size of those changes is difficult to be verified. Some investigations were performed for Poland by Earth Resources Research (ERR) [1.4.27].
For Poland the assumption was accepted, that every car shall drive from 7 000 to 10 000 km per year, for period of 1990 - 2010. In the same time the total number of cars will be twice increased from 5 mln. to 10 mln. Anyway, it will be still fewer than in West Europe countries, where currently 300 to 400 cars are used by 1000 inhabitants, and those figures still increase. In prepared model three cases, based on following premises, were considered:

- different speed of new type of cars introduced to production in Poland,
- proportion of new types of cars fulfilling new emission standards, to old type cars.

The least optimistic case presume, that cars equipped with catalysators shall be sold in Poland from 1995 and that in 2000 they will represent ca 70% of all sold cars.

Nitric oxide emission and fuel consumption calculations results for these assumptions are shown on chart - Draw. 6.1

**Drawing 6.1. Forecasted nitric oxide emission caused by cars fuel consumption in Poland.**

<table>
<thead>
<tr>
<th>A</th>
<th>No emission (tons/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>fuel consumption (thousands tons/year)</td>
</tr>
</tbody>
</table>

This analysis shows that for the future period extreme emission of nitric oxides in exhausted gases from cars shall take place in 2000 year.

In this “Assessment…” it is carefully assumed that the future highest emission shall take place in 2005 year, mainly because of lower increase of cars number equipped with catalysators than presumed in ERR investigations.

In case of cars using gasoline, from the year of 2000, lead emission shall be practically eliminated due to anticipated prohibition of lead compounds emission by vehicles engines [1.4.16, 1.4.17].

6.2. Contamination emission from considered road section

For influence determination of vehicles exhausted gas emission to atmosphere air quality, the analysis is performed for two periods;

- existing state (1995)
- the highest emission future period, i.e. 2005 (according to analyse given in introduction)

Vehicles kind structure and traffic volume have direct impact on exhausted gases emission level. Those elements were fixed in p. 2.4.

Planned investment realisation has no essential impact on exhausted gases emission level – decreased fuel consumption due to better pavement conditions and more fluent traffic are ignored. Contamination emission calculations are performed with consideration of;

- cars fuel consumption indicators, consistent with Transportation Ministry decree [1.4.15]
- indicators of contamination emission from fuel combustion in car engines suggested by Environment Protection Ministry (1.4.20).
- the length of road section, limited by investment project
  - correcting coefficient 0.9 for gas contamination due to introduced modern vehicles (equipped with catalisators).

Appropriate indicators for vehicles in current state are listed in Table No 6.1.

Taking the accepted statements, the following data were obtained;

- the highest emission (Em), typical for average traffic volume in hours 6-22 (emission in night is ca 4.5 time lower),
- average daily emission (E),
- annual emission (Ea).

Calculated contamination emissions for current and anticipated state are given in table 6.2. Anticipated emission for future period will be of 77% higher than in 1995 data.
### Table 6.1 Accepted assumptions - indicators.

<table>
<thead>
<tr>
<th>No</th>
<th>Specification</th>
<th>Unit</th>
<th>Vehicles kind</th>
<th>personal cars</th>
<th>trucks</th>
<th>lorries</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Fuel consumption by 1 vehicle</td>
<td>l/100 km</td>
<td></td>
<td>10</td>
<td>18</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>- gasoline</td>
<td>kg / 1 km</td>
<td></td>
<td>0.073</td>
<td>0.131</td>
<td>-0.298</td>
</tr>
<tr>
<td>1.1</td>
<td>- fuel oil</td>
<td></td>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>Emission indicators</td>
<td>g/kg of fuel</td>
<td></td>
<td>2</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>- sulphur dioxide</td>
<td></td>
<td></td>
<td>33</td>
<td>42</td>
<td>71</td>
</tr>
<tr>
<td></td>
<td>- nitrogen dioxide</td>
<td></td>
<td></td>
<td>240</td>
<td>320</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>- carbon monoxide</td>
<td></td>
<td></td>
<td>30</td>
<td>30</td>
<td>10.8</td>
</tr>
<tr>
<td></td>
<td>- aliphatic hydrocarbons</td>
<td></td>
<td></td>
<td>13</td>
<td>13</td>
<td>4.8</td>
</tr>
<tr>
<td></td>
<td>- aromatic hydrocarbons</td>
<td></td>
<td></td>
<td>0</td>
<td>0</td>
<td>4.3</td>
</tr>
<tr>
<td></td>
<td>- dusts</td>
<td></td>
<td></td>
<td>0.15</td>
<td>0.15</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>Emission indicators for 1 vehicle</td>
<td>g / km</td>
<td></td>
<td>0.146</td>
<td>0.262</td>
<td>1.788</td>
</tr>
<tr>
<td></td>
<td>- sulphur dioxide</td>
<td></td>
<td></td>
<td>2.409</td>
<td>5.500</td>
<td>21.158</td>
</tr>
<tr>
<td></td>
<td>- nitrogen dioxide</td>
<td></td>
<td></td>
<td>17.520</td>
<td>41.920</td>
<td>8.94</td>
</tr>
<tr>
<td></td>
<td>- carbon monoxide</td>
<td></td>
<td></td>
<td>2.190</td>
<td>3.93</td>
<td>3.218</td>
</tr>
<tr>
<td></td>
<td>- aliphatic hydrocarbons</td>
<td></td>
<td></td>
<td>0.949</td>
<td>1.703</td>
<td>1.430</td>
</tr>
<tr>
<td></td>
<td>- aromatic hydrocarbons</td>
<td></td>
<td></td>
<td>0</td>
<td>0</td>
<td>1.281</td>
</tr>
<tr>
<td></td>
<td>- lead</td>
<td></td>
<td></td>
<td>0.0109</td>
<td>0.020</td>
<td>0</td>
</tr>
</tbody>
</table>

### Table 6.2. Contamination emissions by vehicles

<table>
<thead>
<tr>
<th>No</th>
<th>Emitted contamination Kinds</th>
<th>Contamination emission from 1 km of road</th>
<th>Contamination emission in analysed road</th>
<th>Ea [Mg/year]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Em [g/s]</td>
<td>E [kg/h]</td>
<td>Ea [Mg/year]</td>
</tr>
<tr>
<td>I</td>
<td>Existing state (1995)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Sulphur dioxide</td>
<td>0.033</td>
<td>0.088</td>
<td>0.771</td>
</tr>
<tr>
<td>2</td>
<td>Nitrogen dioxide</td>
<td>0.457</td>
<td>1.219</td>
<td>10.678</td>
</tr>
<tr>
<td>3</td>
<td>Carbon monoxide</td>
<td>1.643</td>
<td>4.382</td>
<td>38.386</td>
</tr>
<tr>
<td>4</td>
<td>Aliphatic hydrocarbons</td>
<td>0.219</td>
<td>0.584</td>
<td>5.116</td>
</tr>
<tr>
<td>5</td>
<td>Aromatic hydrocarbons</td>
<td>0.095</td>
<td>0.254</td>
<td>2.225</td>
</tr>
<tr>
<td>6</td>
<td>Dust suspended</td>
<td>0.015</td>
<td>0.040</td>
<td>0.350</td>
</tr>
<tr>
<td>7</td>
<td>Lead</td>
<td>0.0009</td>
<td>0.0024</td>
<td>0.021</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6.569</td>
<td>57.547</td>
<td>861.77</td>
</tr>
<tr>
<td>II</td>
<td>Prognosis for 2005 dioxide</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>0.058</td>
<td>0.156</td>
<td>1.366</td>
</tr>
<tr>
<td>2</td>
<td>Nitrogen dioxide</td>
<td>0.654</td>
<td>2.162</td>
<td>18.939</td>
</tr>
<tr>
<td>3</td>
<td>Carbon monoxide</td>
<td>2.913</td>
<td>7.768</td>
<td>68.048</td>
</tr>
<tr>
<td>4</td>
<td>Aliphatic hydrocarbons</td>
<td>0.389</td>
<td>1.026</td>
<td>8.988</td>
</tr>
<tr>
<td>5</td>
<td>Aromatic hydrocarbons</td>
<td>.169</td>
<td>0.451</td>
<td>3.051</td>
</tr>
<tr>
<td>6</td>
<td>Dust suspended</td>
<td>0.026</td>
<td>0.071</td>
<td>0.622</td>
</tr>
<tr>
<td>7</td>
<td>Lead</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>II</td>
<td>Emission – Total (2005)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>11.634</td>
<td>101.914</td>
<td>1526.16</td>
</tr>
</tbody>
</table>
6.3. **Methodology of ambient air contamination forecasting.**

Influence of exhausted gases from cars on air contamination is determined by calculating method according to appropriate programs for line type sources in accordance of recommended Guidelines...[1.4.18] and by using some elements of their amendments [1.4.19]. Assessment of particular contamination influence is made with regard to valid permissible contamination concentrations ($D_{30}$, $D_{24}$, $D_a$, including contamination background $R_{30}$, $R_{24}$, $R_a$) for areas.

Contamination background was accepted on level given by PWIS [Encl.4]. According to Environment Protection Ministry Decree [1.4.4] permissible contamination concentrations in ambient air are kept if following conditions are fulfilled at the same time:

a) Value exceeding frequency $D_{30} - D_{24} = d_{30}$ by 30 minutes concentration should not be bigger than 0.2% time of the year

$$P_{(d_{30})} < 0.2\%$$

b) Value exceeding frequency $D_{24} - R_{24} = d_{24}$ by 30 minutes concentration should not be bigger than 2% time of the year

$$P_{(d_{24})} < 2\%$$

c) Concentration $S_{mm}$ together with background value cannot exceed twice value of $D_{30}$

$$S_{mm} < 2 D_{30} - R_{30} = D_{30} + d_{30}$$

Swinoujscie meteorological station data were used in air contamination calculations, and especially:

- air average temperature,
- anemometer location height,
- statistics of atmosphere balance states, winds speeds and directions.

In this place the considerable atmosphere balance states participation in imission levels shaping should be underlined. Inversions states \[5,6\], and first of all 6 state of atmosphere balance, definitely increases contamination imission, and it concerns specially low sources of emission. In this state of balance and with very weak winds the maximal contamination concentrations are met. The maximal concentrations many times exceeds the values met in average atmospheric conditions. Relative comparison of atmosphere balance state effect on exhausted gases imission level is shown on draw.6.2.

**Table 6.3. Permissible contamination concentrations in ambient air for areas (mg/m$^3$)**

<table>
<thead>
<tr>
<th>No</th>
<th>Contamination type</th>
<th>$D_{30}$</th>
<th>$D_{24}$</th>
<th>$D_a$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>sulphur dioxide</td>
<td>0.6</td>
<td>0.2</td>
<td>0.032</td>
</tr>
<tr>
<td>2.</td>
<td>nitrogen dioxide</td>
<td>0.5</td>
<td>0.15</td>
<td>0.050</td>
</tr>
<tr>
<td>3.</td>
<td>carbon monoxide</td>
<td>5.0</td>
<td>1.0</td>
<td>0.12</td>
</tr>
<tr>
<td>4.</td>
<td>aliphatic hydrocarbons</td>
<td>3.0</td>
<td>2.0</td>
<td>0.82</td>
</tr>
<tr>
<td>5.</td>
<td>aromatic hydrocarbons</td>
<td>1.0</td>
<td>0.3</td>
<td>0.043</td>
</tr>
<tr>
<td>6.</td>
<td>suspended dust</td>
<td>0.25</td>
<td>0.12</td>
<td>0.050</td>
</tr>
<tr>
<td>7.</td>
<td>lead</td>
<td>0.0035</td>
<td>0.001</td>
<td>0.0002</td>
</tr>
</tbody>
</table>

Permissible lead dust value $D_a = 0.1 \text{ g/m}^2 \times \text{ year}$

**Draw.6.2 Atmosphere balance state impact on exhausted gases imission level - relative comparison at wind speed $w = 3 \text{ m/sec}$.**

Odleglosc od osi drogi – Distance from road axis
Stan 1,2,3,4,5,6 – State 1,2,3,4,5,6

Dangerous meteorological conditions for contamination spreading are mainly met in nights and also in foggy and fully cloudy days. Time of their presence is very often missed with maximal emission of road contamination. So, that is why frequency of high concentrations, statistically calculated, are much higher compare to real.

6.4. **Scope and results of ambient air contamination calculations.**

The basic data for air contamination state calculation is maximal emission ($E_m$) of current and anticipated state, what is given in table 6.2.

Relative analysis of contamination met in exhausted gases is performed in limited scope of necessary calculation. Real emissions are replaced by equivalent ones.
Table 6.4 gives this analysis results, which are clearly showing contamination deciding on scale of exhausted gases influence for considered sources of emissions. These contamination are first of all; carbon monoxide and nitrogen dioxide, and for them the calculations of atmospheric air contamination state is calculated mainly.

Drawing No 6.III - Alignment of analysed section of Road No 6
Legend;
- Area covered by graphical interpretation of contamination imission level

Table 6.4 Comparative analysis of contamination emission influence.

<table>
<thead>
<tr>
<th>No</th>
<th>Types of emitted contamination</th>
<th>Real emission [Mg/year]</th>
<th>Equiponderant emission *</th>
<th>Participation in total Er [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Existing state (1995)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>sulphur dioxide</td>
<td>11.55</td>
<td>18.05</td>
<td>3.3</td>
</tr>
<tr>
<td>2.</td>
<td>nitrogen dioxide</td>
<td>159.90</td>
<td>159.90</td>
<td>29.28</td>
</tr>
<tr>
<td>3.</td>
<td>carbon monoxide</td>
<td>574.83</td>
<td>239.51</td>
<td>43.86</td>
</tr>
<tr>
<td>4.</td>
<td>aliphatic hydrocarbons</td>
<td>76.61</td>
<td>4.67</td>
<td>0.86</td>
</tr>
<tr>
<td>5.</td>
<td>aromatic hydrocarbons</td>
<td>33.32</td>
<td>38.74</td>
<td>7.1</td>
</tr>
<tr>
<td>6.</td>
<td>suspended dust</td>
<td>5.24</td>
<td>5.24</td>
<td>1.0</td>
</tr>
<tr>
<td>7.</td>
<td>lead</td>
<td>0.32</td>
<td>80.00</td>
<td>14.6</td>
</tr>
<tr>
<td>I.8</td>
<td>Emission – Total (1995)</td>
<td>861.77</td>
<td>546.11</td>
<td>100.0</td>
</tr>
<tr>
<td>II</td>
<td>Prognosis for 2005</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>sulphur dioxide</td>
<td>20.46</td>
<td>31.97</td>
<td>3.9</td>
</tr>
<tr>
<td>2</td>
<td>nitrogen dioxide</td>
<td>283.61</td>
<td>283.61</td>
<td>34.3</td>
</tr>
<tr>
<td>3</td>
<td>carbon monoxide</td>
<td>1019.02</td>
<td>424.59</td>
<td>51.4</td>
</tr>
<tr>
<td>4</td>
<td>aliphatic hydrocarbons</td>
<td>134.60</td>
<td>8.21</td>
<td>1.0</td>
</tr>
<tr>
<td>5</td>
<td>aromatic hydrocarbons</td>
<td>59.16</td>
<td>68.79</td>
<td>8.3</td>
</tr>
<tr>
<td>6</td>
<td>suspended dust</td>
<td>9.31</td>
<td>9.31</td>
<td>1.1</td>
</tr>
<tr>
<td>II.7</td>
<td>Emission – Total (2005)</td>
<td>1526.16</td>
<td>826.48</td>
<td>100.0</td>
</tr>
</tbody>
</table>

*) Calculation was made in relation to Da nitrogen dioxide

Calculated level of nitrogen dioxide and carbon monoxide emission is graphically interpreted (draw. 6.3 and 6.4) in relation to estimation criteria given in p.6.3, for area illustrated in draw. 6.III.

Anticipated scopes of standards exceeding contamination influence are represented by following isolines;
- frequency of \( D_{30} \) and \( D_{24} \) permissible concentration excess by 30 minutes concentrations \( P_{D_{30}} = 0.2\% \) and \( P_{D_{24}} = 2\% \)
- average annual concentration \( S_a = D_a \).

Isolines of nitrogen oxides distribution showed on draw. No 6.5 have illustration character only.

6.5 Assessment and Conclusions.

Scopes of standards exceeding influence of nitrogen dioxide and carbon monoxide, given on drawings 6.3, 6.4 and 6.5 should be considered as maximal calculative ones, much bigger than expected real data. It concerns especially scopes showed by frequency isolines due to aspects explained in p.6.3. As authoritative values for Assessment purposes, first of all, scopes determined by average annual concentrations \( S_a = D_a \) should be accepted.

The whole performed analysis gives following conclusions;
1) Exploitation of considered road section causes currently local decrease of air quality below required standards, mainly due to nitrogen dioxide and carbon monoxide immission. The scope of exhausted gases excessive influence is represent by isoline \( PD_{24} \).
2) The further decrease of air quality will take place up to 2005 year, but in degree not dangerous for environment.
First of all, the roadside dwelling buildings and roadside greens will be exposed for excessive gases influence (scope of influence – isoline $P_{D24}$). Expected scope of these excessive influence is showed by average annual permissible concentrations of nitrogen dioxide in draw. 6.3.

3) Pavement quality and traffic fluency improvement are advantageous factors to exhausted gases emission reduction; emission will be grow up to 2005, what is caused by increasing traffic volume and is dependent in small extent on road modernisation.

**Drawing 6.3. Scopes of nitrogen dioxide influence caused by Goleniów – Nowogard road exploitation.**

1) stan istniejący – existing state  
2) Prognoza na rok 2005 – prognosis for 2005  
Zastępcze źródło liniowe - substitutional linear source  
Izolinie imisji (uwzględnione tlo 0,3 D) – Immission isolines (0.3 D background is covered)

**Drawing 6.4 Scopes of carbon monoxide influence caused by Goleniów – Nowogard road exploitation.**

1) stan istniejący – existing state  
2) Prognoza na rok 2005 – prognosis for 2005  
Zastępcze źródło liniowe - substitutional linear source  
Izolinie imisji (uwzględnione tlo 0,3 D) – Immission isolines (0.3 D background is covered)

**Drawing 6.5 Maximal concentrations $S_m$ + background [mg/m$^3$] of nitrogen oxides in Road No 6 area.**

1) stan istniejący – existing state  
2) Prognoza na rok 2005 – prognosis for 2005

7. ACOUSTIC CLIMATE ANALYSIS.

7.1 Purpose and Scope of Acoustic Analysis.

Transportation noise and vibrations are more and more frequently reason of citizens complaints for annoyances, which causes in further consequence different kind of diseases.

Transportation noises have dominant influence on environment acoustic climate. Noise level in direct surrounding of transportation routs depends first of all from engines and exhaust systems work at low speed driving and from rolling noise at higher speeds. Vehicles constructors have brought to significant decrease of emitted noise by improvement of driving systems, cars outlines and tyres characteristic, but anyway noise levels generated by road traffic are in range of 75 to 95 dB. In respect of particular kinds of vehicles these values are as follow;

motorcycles 79-87 dB,  lorries 83-93 dB,  buses and tractors 85-92 dB,  cars 75--84 dB,  road and building machines75-85 dB [1.4.23].

As above data show, especially heavy vehicles, buses and tractors traffic is the source of high level noise.

High levels of sound emission, exceeding a few decibels of Polish standard requirements applied for domestic cars producers have caused very serious excesses of permissible sounds intensity levels in environment as well as necessity of noise limitation actions performance.

It concerns not only emission level limitations in sources but also appropriate designing of new and reconstruction of existing roads.

Planned National Road No 6 modernisation, on section from km 30+425 to km 45+400, i.e. from Goleniów northern by-pass to designed Nowogard by-pass consist on existing road parameters improvement to express road requirements.

The purpose of this acoustic analysis is estimation of planned road modernisation influence on acoustic climate change as well as estimation of environment threatening by standards exceeded noise. Assessment of acoustic climate change should indicate threaten areas. It should also give the answer, by which way this investment should be managed, and what actions should be undertaken in next stages of design and construction to significantly reduce planned investment annoyances for environment in noise emission aspects.

The Assessment of modernised road section influence on acoustic climate change in this area was performed for two periods;
7.2 General Character of Planned Investment Area

The road traffic from Szczecin to Koszalin and further to Gdynia and Gdansk is currently going through the Goleniów and Nowogard towns. The National Road No 6 is running through the central parts of these towns, what has caused, especially in the latest years, citizens complaints for annoying noise and vibrations connected with intensive traffic (especially heavy vehicles). This is mostly transit traffic, i.e. traffic of vehicles not interested in these towns crossing.

In connection with road traffic volume increase in Goleniów town area, much more than earlier prognosis assumed, new by-pass of the town is under construction, and it should essentially improve journey conditions in relations Szczecin – Gdansk and Szczecin – Swinoujscie.

Modernisation of analysed road No 6 section from km 30+425 to km 45+400 (i.e. from northern by-pass of Goleniów to designed Nowogard by-pass) as well as adjustment of existing road to required parameters of express road is consequent continuation of earlier works.

The road design assumes that basic parameters of modernised road (essential for road capacity and also for noise emitted during traffic operation) will be as follow;
- design speed $V_p = 100\, \text{km/h}$
- carriageway width $7.0\, \text{m}$
- hardened shoulders width $2 \times 2.0\, \text{m}$
- soft shoulders width $2 \times 0.75\, \text{m}$ (in road barriers places $1.25\, \text{m}$)

The areas directly adjacent to the road are generally agriculture areas, fields, pastures, barrens, and partly forest. Trees and bushes occur on both sides of the road in different sections. In area of some villages crossed by the road, there are dwelling buildings in direct vicinity (single houses and housekeeping buildings).

7.3 Descriptions of National Road No 6 Considered Section

The considered section of the road No 6 begins in km 30+425, at connection to Goleniów northern by-pass. In further part, the road is running through forest area to Glewice village. There is the southern east bound exit in km31+600 to airport. In Glewice village of 33+500 km there are dwellings houses with housekeeping buildings on road northern side in 10-15 m from the road (one building is ca 1-2 m close to the road). On the road southern side the Joiner’s Shop and a little further dwelling buildings (in distance of 15 – 20 m from the road) are located.

The forest is enlarged to ca 39 km.

Km 39 + 600 – exit to Radostowo. The nearest dwelling buildings are located in distance of 250 – 300 m from the road.

Km 40 + 800 – Kikorze village. On the southern and northern side of the road some solitude dwelling buildings are located in distance of 40 – 70 m. Further, on southern side dwelling buildings are located in bigger distance, ca 120 – 150 m. Behind the exit to Osina village, km 42+800, there are two dwelling buildings in 10 – 15 m distance of the road.

Km 44+400 - Filling Station.

Km 44+450 – single dwelling buildings of Olechowo settlement. These buildings are located on northern and southern side of the road, in 15 – 30 m distance of the road along the section of ca 300 – 500 m.

At the entrance to Olechowo (the beginning of planned by-pass of Nowogard town), there are single dwelling buildings in 50 – 80 m distance of the road (from km 45 + 500).

7.4 Permissible levels of noise.

Permissible sound levels on areas protection against noise required are expressed by equivalent levels for day and night time. Time of equivalent level assignation $L_{\text{Aeq}}$ is;
- for day time - 8 the most unfavourable hours in time of $0_{00} - 22_{00}$,
- for night time - 0.5 value of the most unfavourable hours in time of $22_{00} - 6_{00}$.

Values of permissible sound levels (equivalent), both for daytime as night time are given in table - Enclosure do Ministry Council decree of September 30th 1980 on Protection against Noise and Vibration [1.4.5].

Those values depend on particular area function fulfilled.

The Decree mentioned above concerns mainly to urban areas, so first of all to towns areas.

Considering dwelling buildings, it is classified for noise protection needs on base of location in respect to town arrangement. Anyway this classification does not concern rural areas. Trying to
compare suburban dwelling areas and country areas in respect to acoustic requirements, it is possible to accept permissible noise levels for villages as the class “2”.

For areas qualified to class “2”, following permissible levels of noise intensity in environment should not exceed values;
- equivalent sound level $L_{eq}$ - 45 dB(A) for daytime
- equivalent sound level $L_{eq}$ - 35 dB(A) for night time
- maximal short sound level - 70 dB(A).

On country areas permissible levels concern so called dwelling parcels area. For agriculture area (fields, pastures) no permissible standards of noise level are assigned. Simply, these areas are not secured from acoustic point of view.

Listed above permissible values concern to current legal state. So, when this analysis making, the expected changes in law and its adjustment to European standards were taken into account.

The current trends of law are going to:
- requirements equation for all dwelling areas (urban and rural)
- dividing the noise assessment of industry and transportation origin

It is justified assumption, that permissible transportation noise levels for country building may be;
- equivalent sound level $L_{eq}$ = 55 – 60 dB(A) for daytime and
- equivalent sound level $L_{eq}$ = 45 – 50 dB(A) for night time

Due to the fact, that considered section of the road is running mainly through agriculture or forest areas, which are not protected against noise, the dwelling areas were first of all taken into analyse, and following permissible values of noise levels were accepted;
- equivalent sound level $L_{eq}$ - 55 dB(A) for daytime
- equivalent sound level $L_{eq}$ - 45 dB(A) for night time
- maximal short sound level - 80 dB(A).

7.5 Investment Influence on Acoustic Climate Change.

7.5.1 Noise Influence during Modernised Road Works.

During modernisation works and road embankment construction, periodical acoustic and vibration annoyances will take place, mainly caused by heavy road machines and transportation vehicles. Equipment, which will be used for road works, i.e. bulldozers (of 100 KM engine power), excavators, graders, static and vibration rollers, machines for bituminous mixes and subbase loading, is always the high noise emission source. This influence is anyway acting in respectively short time, and spatial scope of noise emitted by group of working road machines and servicing vehicles may be estimated for 200 to 300 m for planned scope of road earthworks.

If the works on discussed road section will be carried out in dwelling areas only in daytime, and modern equipment (suitably noiseless) will be used, the annoying noise influence is significantly limited. It should be anyway noted, that works made with heavy equipment using, shall cause permissible values of noise exceed, especially in dwelling areas, so such works could not be carried out in night time.

7.5.2 Traffic Noise Emission Anticipation Method

Acoustic analysis were based on calculative methods of transportation noise assessment, implemented in frame of “Rules of environment protection in designing, construction and maintenance of roads”. [1.4.24]. This rules use mathematical model in calculations, elaborated on theoretical investigations, simulations and empirical base.

This model used for calculations may be characterised generally in following way;
- road is treated as linear source of sound, located on 0.5 height over pavement, 3.5 m distant from its edge,
- initial value for noise scope determination is calculated as so called “at source” noise level,
- noise level at source is corrected by few corrections depend on observation point distance, so called source sight angle, possible screening and ground cover.

Anticipated value of sound level in point of interest is in this way determined. Essential thing is road modelling by ideal linear source of sound using, so the rule of noise level decreasing by 3 dB for every 2 times distance increasing is assumed. This method is based on rather simplified models, what can give a little higher calculations results.
7.5.3 Current State and Forecasted Noise Level for 2010

Using above mentioned calculative method of transportation noise assessment, the calculations were made for current state and for prognosis (for year 2010), by determining noise level in reference point and annoyed noise influence (with permissible noise values data discussed in previous chapter).

In calculations on this stage of design and project agreement, for global scope of the road section influence assessment, the road alignment was presumed without respect to ground levelling differences and road surrounding changes (what has doubtless impact on acoustic absorbency of the site, and in consequence on noise spreading).

Basic calculations of forecasted noise levels in daytime and night time in considered road surroundings, were performed for current state. The results of average daily road traffic measurement in measuring point No 4103069 (General Traffic Measurement 1995 – Encl.3) gives:

- 6270 vehicles/24 hours, - heavy vehicles participation of 13.3%,
and traffic prognosis for year 2010 for discussed road section, (see p.2.4), gives average daily traffic volume 14728 veh/24h.

Participation of heavy vehicles and buses (noise making vehicles) for this assessment purposes was accepted unchanged.

Detailed data and calculations results are given in Enclosures;
Enclosure No 5.1 – data and results of noise level currently existing in daytime, at the road (at sources) – \( L_{tr} \) (\( L_{Aeq} \)) and noise scope of influence
Enclosure No 5.2 – data and results of noise level currently existing in night time, at the road (at sources) – \( L_{tr} \) (\( L_{Aeq} \)) and noise scope of influence

The calculations of emitted noise level and its influence to analysed road section pointed out;

- equivalent sound level \( L_{Aeq} \) in day time in the road area (at source),
at currently existing average daily road traffic volume 6270 vehicles and 13.3% of heavy vehicles participation is 70 – 71 dB(A),
- scope of annoying noise influence is in average ca 85 – 100 m
- for night time, at decreased intensity of road traffic \( L_{Aeq} = 68 – 69 \) dB(A), and noise influence scope is ca 280 m.

Immediately after road modernisation completion, due to pavement improvement, noise level will be lower, but traffic volume increase (14 728 veh./day in 2010) and traffic speed increase (100 km/h was assumed) will again cause the noise level increase in the road area above currently noted;

\[ L_{Aeq} = 70 – 71 \text{ dB(A) in daytime} \]
\[ L_{Aeq} = 68 – 69 \text{ dB(A) in night time} \]

Anticipated scope of noise influence for year 2010, given in draw. 7.1 should be taken as minimal.

Drawing No 7.1 Scope of Modernised road caused noise influence.

Legend;
Zasieg oddzialywania halasu w porze dziennej – Scope of noise influence in daytime
Zasieg oddzialywania halasu w porze nocnej – Scope of noise influence in night time.

7.6 Assessment and Conclusions

1) According to carried out calculations, the scope on annoying noise influence is ca 85 m in daytime and ca 280 m in night time

2) The current acoustic climate assessment points out, that even now, on analysed road section the significant exceeds of permissible noise levels exist at dwelling buildings close to road areas. It concern following buildings;
- in Glewice village - dwelling buildings located in 2 – 60 m distance off the road
- in Kikorze village - dwelling buildings located in 10 – 100 m distance off the road
- in Olechowo village - dwelling buildings located along the road and in 10 – 100 m distance off the road

For these dwelling buildings, on the next stage of design, suitable acoustic fittings should be foreseen, for example acoustic screens.
3) Planned modernisation and reconstruction will not basically change the acoustic climate on the road area. Road pavement will be improved indeed, but traffic volume and vehicles speed will also grow.

The emitted by vehicles traffic on the National Road No 6 noise screening is beside road pavement improvement, the only way for acoustic climate remedy in area of existing dwelling buildings.

According to Art.43, p.1 of Act on Public Roads of 21.03.1985 [1.4.8a], building objects near the express roads should be located in distance of at least 20 m from carriageway outer edge.

4) The temporary noise intensity increase in environment will take place during road modernisation period. To get its possible maximal limitation, the following action should be undertaken;

- the Contractor’s background area should be located in a way giving possibility of efficient operation in every stages of investment realisation and should be in maximal possible distance from dwelling area.
- specially annoying, noisy works made by heavy equipment like bulldozers, excavators, heavy trucks etc. in dwelling area should be performed exclusively in daytime (best in hours of the first shift),
- greens arrangement (trees and bushes) should be planted in the road surrounding as soon as possible, to give the proper acoustic insulation for nearby dwelling buildings.

5) In the 100 to 120 m wide belt off the road any new dwelling buildings should not be located, because if they are not screened, they will be exposed for noise permissible levels exceeding.

8. RESUME AND FINAL CONCLUSIONS

The National Road No 6 on the section to be modernised is mostly running on even area of good soil conditions. At least 85 % of the road length shall not create any problems with pavement widening and shoulders forming. In great extend, there are sand soils, usually fine or medium size.

Some difficulties may be appeared in shallow ground water, mainly in central part of the road (km 36 to km 38). On east part of the road, near Glewice village, ground water also appears comparatively shallow.

Definitely bad soil and water conditions appear in valleys of Gowienica and Stepnica Rivers. Essential problem may be with embankment and engineering structures realisation on weak ground subsoil.

During investment design and execution stages, the following factors should be considered;

- ca 20% of acceptable soil for embankment may be obtained from local sources for the modernisation works
- remaining embankment soil should be transported from another sources
- aggregate acquisition in close vicinity of the road is possible only in central section of the road, i.e. in Kikorze and Osina area.
- embankment construction in rivers valley should be formed in advance, gradually, for uniform settlement procurement
- all humus layer on area covered by the works should be removed and afterwards used for road landscaping works

It is also recommended;

- to remove all dispensable old constructions and its parts
- to direct refuse materials to the nearest communal refuse dump in Podansk near Goleniów town or in Slajsin near Nowogard.
- to direct concrete or reinforced crushed concrete elements of structures for terrain fitting needs, and not for communal refuse dump.

Natural recommendations:

1) In case of works interference with ambient greens, the detailed greens inventory and investigations should be made
2) Open boundaries of forest, caused by trees and bushes cutting should be protected by designing and implementing suitable vegetation screens. The species of trees and bushes of native origin should be carefully selected.

3) Formed shoulders and slopes of the road as well as new bridges abutments area should be seeded by suitable grass mixtures. Expansive species of grass should be avoided.

4) Screens of greens are also recommended to design in places, where road is going in direct vicinity of human settlements and agriculture areas. These screens should form so called biological timbering of the road.

5) Recommendations listed above should be implemented on stage of final design of the road.

**Determinations on rainfall waters flow:**

1) Some pollutants concentrations in flows are higher than acceptable indexes of sewage waters introduced to natural waters [1.4.9], it concerns; Common Suspension, ChZT and BZT₅

2) Assignment of planned investment into operation shall favour the flow quality improvement because pollutants concentrations in sewage shall be lower. Due to vehicles traffic increase, the pollution volume shall be heightened; in 2010 shall be bigger of ca 15% in compare to existing state.

3) Rainfall waters from carriageway should be directed to road ditches. Ditches and dewatering drainage need careful shaping, and it especially concerns section of the road from km 36+000 to km 38+400.

**Influence of the road modernisation and maintenance into ambient air quality.**

1) During modernisation period, the pollution emission shall not be an essential threat for environment.

2) Assignment of modernised road into operation will cause decrease of ambient air quality, but in extent not dangerous for environment. For excessive pollutants action, first of all the roadside dwelling building and the greens will be exposed.

Maximal calculative scope of the highest emission influence in future period shall be respectively 60 and 40 m off the road axis.

3) Pavement quality and traffic fluency improvement favour the exhausted gases decrease, but as the result of increasing traffic volume to 2005 year, pollution emission of vehicles shall be increased.

**Traffic noise influence.**

1) Existing road traffic causes significant scope of traffic noise annoyance.

Maximal calculative scope of this influence is;
- 85 m in daytime
- 280 m in night time

2) Realisation of planned road modernisation shall enable traffic fluency and road capacity, and shall not make substantial changes of acoustic climate in the road vicinity and shall not make limitations of burdensome noise emission.

So, for these reasons, some necessary dwelling buildings demolition or changes in their using destination should be implemented, as well as additional protections (for example acoustic screens) should be considered. These means should limit burdensome noise spreading into dwelling area close to modernised road.