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# Alternative Energy Promotion Centre

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Government of Nepal

## MUNICIPAL SOLID WASTE BIOGAS PLANT PROJECTS

## DETAILED FEASIBILITY STUDY REPORT GUIDELINES

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March, 2015



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## **GENERAL REQUIREMENTS**

The following document sets the guidelines for submitting a DFS to request support from the AEPC. The DFS report must follow the contents established in these guidelines and follow the online process for Municipal Solid Waste (MSW) biogas plants.

Please ensure that the DFS and all attachments are legible. All supporting documents (attachments) should also have the name of the project on them. Submit one original copy of the DFS (soft and hard copy) to the Alternative Energy Promotion Centre (AEPC), Khumaltar, Lalitpur G.P.O. Box No 14364, Kathmandu. Keep a copy of your DFS for your own records as the one you submit will not be returned.

Project proponents shall make the applications via the Waste to Energy Portal: [www.w2ebazaar.org.np](http://www.w2ebazaar.org.np) .



## DFS REPORT GUIDELINES

### 1. INTRODUCTION

#### 1.1 Title or cover page

- The title or cover page shall have the name of the DFS. The page shall indicate clearly the following:
- Name of the company, organisation submitting the DFS
- Name, address and phone number of the Developer and its designated contact person. A fax number (if available) and e-mail address for the contact person shall also be indicated on the title or cover page. The Developer's designated contact person is the individual who shall be the main point of contact for the AEPC to communicate with regarding the project.
- Date of submission of DFS.
- Name, address and phone number of the Technology Provider and its designated contact person. A fax number (if available) and e-mail address for the contact person shall also be indicated on the title or cover page.
- Name, address and phone number of the Consultant(s) that completed the DFS and its designated contact person(s). A fax number (if available) and e-mail address for the contact person shall also be indicated on the title or cover page.

#### 1.2 Project Salient Features

This section should be used to summarise the main highlights of the project. This should include the following:

- Area of implementation of the project
- Start and end dates (Start date defined as Construction Start date and End Date as Testing and Commissioning date)
- Type of technology
- Number of beneficiaries, this could be in the form of the community that benefits from waste management service. Similarly, the beneficiaries could be, if biogas or electricity is sold to the nearby households, industries that may purchase energy or the developer/user if energy is for captive use,
- Projected Daily Waste Volume processing
- Biogas production
- Electrical output
- Financing sources for the project (equity, loan, government support, private investors, other)



- Main financial indicators

### 1.3 Executive summary

The Executive Summary shall be an overall review that highlights the key features of the Developer's approach to the Project.

The executive summary shall include the main findings of the DFS, conclusion and recommendations. It should clearly state the viability of the project technically, financially, environmentally and socially.

The following sections should be included in the summary:

- The nature of the project shall be described here, including for a brief overview of the type and amount of waste to be treated, the type of digester and the type of technology, volume, its application and the benefits from the implementation of the project.
- The general setting of the project location shall also be included in the project summary, supported by a brief justification on why this is the most suitable.
- A description of the ownership model of the scheme and the management structure should be included in this section, specifically how will the plant be operated and by whom and the level of training that will be provided.
- An overview of the existing market shall be detailed here, identifying the end uses of the product streams from the biogas plant. The executive summary shall also contain the main findings from the financial analysis.
- The executive summary shall also present a brief description of the resources, both material and human, required to make the project successful, and what the potential for employment creation will be.
- The executive summary shall present brief information about the main actions that have been taken to address any issues that appeared from environmental and social screening during the Feasibility Study stage as per Environment Management Framework (EMF) and Social Management Framework (SMF).
- The executive summary shall conclude with a final, clear statement determining the viability of the project from a technical, environmental, social and financial perspective.

### 1.4 Scope of the project:

This section should comprise the following:

- Description of the contents of the project.
- Main objectives of the project, these being efficient production of biogas, effluent and waste treatment, electricity production, thermal energy production or any other applicable
- Geographical area of the project and main limitations.
- Description of the technology and location proposed, including the potential uses that the project may give to the biogas or slurry, the type of digestion process or the type of digester to be installed.
- Performance guarantees that the Construction Company commit to demonstrate during the commissioning and testing stage.
- The Construction Company is encouraged to partner with the Technology Provider and enforce the achievement of the Performance Guarantees as part of their contract.



## 2. Organisational background and Capacity to Implement the Project

### 2.1 Organisational background and capacity

This section should demonstrate that the proposing organization has the experience, capacity, and commitment to successfully implement the proposed project. The issues to be covered in this section include:

- Nature of the proposing organization – is it a private or public limited company, joint venture, community-based organization (CBO), national or sub-national NGO, etc.
  - Company/Organisation registration certificate
  - PAN and/or VAT registration certificate
  - Tax clearance certificate of the previous fiscal year
- Purpose and core activities of the proposing organization/group
- Organizational approach for project implementation, i.e., how does the organization or group intend to deliver the project? This section shall identify the key staff that will be involved in the Project from development throughout implementation and the role they will perform in Project delivery. Signed CVs should be included in the appendix.
- If the Developer is a team or consortium, the roles of each partner shall be described here. The relevant experience of each entity as well as key management staff who will be assigned to the Project should be highlighted. Any work planning to be subcontracted should be specified here.
- Whenever a Technology Provider (TP) is part of the consortium, especially in cases where the technology to be installed is new to Nepal and is delivered by an International Technology Provider, the role of the TP shall be clearly defined. The Technology Provider and the Pre-Qualified Construction Company shall form a partnership. Construction Companies and Technology Providers are free to partner as they wish.
- The Developer, the Technology Provider and/or the Construction Company shall be tied to the Performance Guarantees as per the project expected results (biogas and electricity generation).
- The following documents should also be included as part of the DFS or in the Appendices section.
  - Developer's length of existence and project management experience
  - Developer's organizational structure, governance and administrative framework
  - Tax clearance reports.
  - If relevant, state membership and affiliation to associations or umbrella groupings
  - Provide an indication of the legal status.
  - Target population group if the beneficiaries are non-commercial (indicate relevant community groups, women, indigenous peoples, youth, etc.)



- The Developer, TP and Construction Company shall explicitly describe previous experience relevant to the proposed project including, as relevant: solid waste management, waste to energy technologies (biogas), etc. If the Developer does not have any direct experience in the sector, any other past project information relevant may be included here that may assist demonstrating its ability to deliver projects.
- Developers, Construction Companies and Technology Providers are encouraged to identify reference installations where the proposed technologies have been successfully implemented for the same waste material/substrate in a similar volume. For the reference installations, include the name of the installation, location, cost, size, age, type of technology being referenced, and installation contact name and phone number.

## 2.2 Implementation schedule

The schedule should clearly illustrate the major activities, milestones, and interdependencies necessary to design, construct, permit, commission, training and operation of the proposed Project by the planned project completion date.

This section shall include a project programme in the form of a Gantt chart or similar describing the main activities, milestones and critical path.

## 2.3 Legal framework, coordination and interaction

This section shall include the following:

- Status of the land where the project will be implemented: details of -any land-lease agreement, duration, landlord views regarding the project, etc. shall be included here. Clear definition of the ownership of the land shall be included here.
- Permits: any permits required from the local authorities shall be included here, and whether these have been obtained or not and, if not, plan to obtain them.
- Mechanisms for interaction with the various parties such as AEPC, the local community, regulatory agencies, approving and authorizing entities, etc
- If electricity or biogas is proposed to be sold to the local community, a description of the course of action to date for dealings with them needs to be described, evidence of agreement for payment and service delivery agreement, metering arrangements if any, and reference to any agreed penalties for non-performance, and a plan on how to develop or expand this relationship in the future.
- Any evidence of signed agreements with the authorities and with proposed customers should be referenced to here and included in the Appendix section. Any agreement with local authorities regarding land lease for developing the project should be stated here and included in the appendix.



### 3. Technical Report

This section shall define the proposed Project, including the technical information necessary to convey a clear understanding of the proposed system(s).

#### 3.1 Energy Demand Assessment

This section shall contain an assessment of the projected captive energy needs of the project, detailing the cost and the quantity and type of fuel that will be used. This shall check the Feasibility Study findings and expand as appropriate in more detail It shall account, as a minimum, for the following:

- 
- If selling excess electricity/biogas to the nearby community, an assessment of the target customers' energy demand shall be included here as per above. Details of type of fuel and current costs incurred required.
- If selling excess electricity/biogas to nearby industries, an assessment of the target industries' energy demand shall be included here as per above. Details of type of fuel and current costs incurred required.

#### 3.2 Waste Assessment

The DFS report shall provide the following information:

- Quantitative analysis of the waste available as feedstock, confirming assumptions made during the Feasibility Study by, as a minimum, a sampling regime over a period of time during which waste is weighted to estimate total waste available.
- Waste Characterisation of the source vicinity from where the waste has to be collected. This shall comprise, composition of the waste, percentage bio-degradable substances, minimum Total Solids %, Volatile Solids %, COD, BOD and C:N ratio.
- Biogas potential generation for the waste selected.
- Variations in waste availability due to seasonality, projected growth or decrease, or other factors that may affect it.
- Identification of any potential sources for inhibition. This could be in the form of an assessment of current waste collection practice like mixing of other wastes especially health care waste in municipal waste stream etc.
- The Consultant shall carry out a detailed waste characterisation of the feedstock (TS%, VS%, COD, BOD, C:N ratio, potential inhibiting substances as a minimum, and any other that the consultant deems relevant for the project)

##### 3.2.1 Waste Management Sector

- In this section the organisation carrying out the DFS should examine the waste management sector. This is a key part of the FS as the substrate availability, management and type will largely determine the viability or otherwise of the project.
- It is important to identify any existing waste management operators in the area and what are their current practices and equipment used, in particular how effective the segregation at source





is and their sorting practices. Consultants shall carry out an evaluation on how many people is employed currently by the waste sector and what are the roles each worker plays in the system. This will help determining whether any other screening process needs to be implemented and assist in predicting impact on employment once the project is implemented, as well as identifying potential contributors to collection and management of waste. Any partnerships with existing organisations in charge of the waste management operation should be referred to in here and any signed agreements included as part of the appendices.

- The assessment should also evaluate the source of waste (household, restaurants, hotels, schools, hospitals, factories, etc) is available and what will be fed to the digester.
- Where the solid waste is mixed, the components of the mixture should be described by percentage composition of the total (i.e., glass, metal, organic waste, wood, paper, etc).
- The quantity of each substrate should also be determined, both current and future predictions, accounting for projected population and industrial growth, as this will have an impact on the size of the digester.
- Current frequency and equipment for the collection of waste should also be established. Areas in which waste is not collected should be identified as this may be part of future plans for waste collection. Any existing facilities for temporary storage should be identified, as well as what the current practices for waste disposal are (open dump, landfill, etc.), and any pre-treatment being used prior to disposal.
- The DFS should also describe whether the area to be covered is urban or rural, as the density of the population will have an effect on the collection and transportation systems.

### 3.3 Design and Technology

The DFS shall be in sufficient detail so that the Technical Review Committee can ascertain the Project's ability to comply with the Performance Guarantees (which shall be detailed in the commissioning section below).

This section shall describe the technical approach for the implementation of the project, including the following:

- Type of technology chosen for the biogas plant and justification. Detailed description of the process and the technology. For any technology imported, a design specification shall be provided (that is, treatment capacity, rating, or other parameters that may apply to the technology as per information from the supplier).
- Description of the useful life of the proposed facility and its encompassing technology, the facility's and technology's susceptibility (if any) to upgrade, expansion, replicability, or retrofit, how it will keep up with production increases and the expected disposition of the facility at the end of its useful life.
- Main plant operational parameters, including feed rate, pressure, temperature, biogas production, expected VS destruction, hydraulic retention time, water requirements and water availability assessment for dilution, feed dry solids, pH, expected slurry production for fertilizer, etc.



- Design and sizing criteria for all process units, including the digester, gas storage, pre-treatment (such as settlement, shredding machines, etc), post-treatment (such as composting or other).
- Size and volume of all unit processes detailed above.
- If electricity is generated, detailed sizing of the engine-generator set, including a detailed load demand analysis accounting for peak and average loads, and reasoning behind the rating selected.
- Final Process Flow Diagram showing all the main streams and their composition– i.e., mass and volume flow rate and dry solids, quantity of different feeds, fertilizer production, etc., and main process parameters such as temperature or pressure. Assurance shall be provided that the electrical design will be compliant with national regulations.
- Details of biogas pipeline material, size, length and route shall be provided.
- Process and Instrumentation Diagram for the plant, including an overall control philosophy.
- Design features covering the safety aspects of the plant to prevent explosions, methane leakage to atmosphere, intoxications or other shall be provided.

### 3.4 Construction

In this section, the report shall include the following:

- GPS location of the plant, map of the area and a brief description of the surroundings including distance to markets, settlement, collection area etc.
- Location of the plant and justification of why the selected location is the most appropriate to build the biogas plant. Photographs and schematics shall be provided to illustrate the description. A description of the design and layout features that allow for easy access regarding operation and maintenance of the main units shall also be included here.
- Site layout plan to scale showing the location of the main process units, including a services plan with and indicative route for the biogas pipe, electricity cables, and water source and delivery pipe. The site layout plan shall clearly demonstrate that the area available is enough for building the biogas plant and installing all ancillary equipment and other processing activities.
- Expandability of the project: The report shall describe the master plan for the site to allow for future expansion (if any) of the facility. If the project has potential of being replicated in other sites across Nepal this should be emphasised here.

### 3.5 Testing and Commissioning

This section shall describe the testing and commissioning approach for the Project to achieve a reliable facility.

- This section shall state the Performance Guarantees that the Developer, Construction Company and/or Technology Provider commit to achieve during testing and commissioning of the plant for biogas and electricity generation.
- The design shall allow for the necessary instruments to be installed in the plant in order to demonstrate compliance with the Performance Guarantees.



- Any other tests that will be used to demonstrate the technical soundness of the installation such as construction completion tests (including water tightness tests, gas tightness tests, etc) shall be described here and comply with AEPC's testing and commissioning guidelines.

### 3.6 Operation and Maintenance

The aspects of facility operation, maintenance and management to ensure the reliability of the plant shall be described in this section, including the following:

- Organisational chart clearly indicating roles and responsibilities for the facility operation and maintenance. All staff involved in the Operation and Maintenance shall be described here.
- A high level maintenance requirement schedule of the main components
- Procedures for record keeping of plant operation, maintenance schedules and gas and electricity generation monitoring shall be stated here as this may affect the guarantee.
- The organisation shall describe what reporting mechanisms to AEPC are in place in the event of incidents affecting the health and safety of its own workers or the public.
- Proposed training programs

### 3.7 Sustainability of Results Achieved

Sustainability is a critical aspect for all projects in which the AEPC is involved. The DFS should outline the steps to be taken before, during, and at project completion to ensure that once all the investment funds have been disbursed, the project impact will continue for many years thereafter.

The funds provided by the AEPC are primarily seed funds, designed to give the project a significant start. However, project proponents should envision the project years after AEPC funds have been utilized, and consider the factors that could contribute to the success and continued impact of their project, and address them accordingly.



## 4. Environmental and Social Safeguards

### 4.1 Environmental Safeguards

The study shall include details on the outcome of the environmental screening carried out during the Feasibility Study to comply with the environmental safeguards, and describe how any recommendations necessary for compliance with the EMF were carried out as per the action plan. Evidence of compliance with EMF shall be provided. The recommendations [Environmental Management Plan (EMP), Environmental Impact Assessment (EIA), Initial Environmental Examination (IEE)] from the environmental screening process shall be accomplished and need to be annexed to the DFS. Brief information about the possible impacts as well as their mitigation measures shall be presented in this section.

[The EMF guidelines are available in the Waste to Energy website for reference.](#)

### 4.2 Social Safeguards

- 5 The Study shall include details on the outcome of the social screening carried out during the Feasibility Study for to comply with the social safeguards, and describe how any recommendations necessary for compliance with the SMF were carried out as per the action plan. Evidence of compliance with SMF shall be provided. The recommendations [(Social Impact Assessment (SIA)/Resettlement Action Plan (RAP), Abbreviated RAP and/or Vulnerable Community Development Plan (VCDP)] from the social screening process shall be accomplished and need to be annexed to DFS. Brief information about the possible impacts as well as their mitigation measures can be present in this section.
- 6 The number of beneficiaries reached and a justification on how these are reached is required here. This could be in the form of the community that benefits if biogas or electricity is sold to the nearby households, industries that may purchase energy or the developer/user if energy is for captive use.

[The SMF guidelines are available in the Waste to Energy website for reference.](#)



## 5. Financial Plan

The Developer shall present an overall financial plan of the project proposed in order to demonstrate its ability to finance the Total Project Cost (TPC). The financial plan should include projected financial statement (income statement, balance sheet and if possible cash flows) for at least five years or the tenure of the loan, whichever is longer. The Developer shall be clear on the definition of Total Project Cost, which is as follows:

**Total Project Cost:** This includes fixed cost for the biogas plant, machinery and associated civil works (construction that includes labour, consulting and management fees) and environmental and social mitigation measures recommended under Environmental and Social Management Framework (ESMF).

When accounting for the TPC, therefore, other installations such as fencing, offices, or any other equipment not directly related to the biogas plant shall be excluded from the calculation.

The financial plan shall include the following:

- Assumptions used for projected financial statement and sensitivity analysis.
- Total investment required for the project in terms of debt, equity and subsidy from the AEPC as per ratio proposed to finance the project.
- Details of the agreement with the financial sector partners should be described here as well as the financing terms which include tenure of the loan (debt), interest rates and fees, and the collateral/security that have been considered.
- If appropriate, any other type of investment from a private investor, NGO, ODA grant, CDM financing, etc.

Please note that if the bio gas project is an extension of an existing/on-going venture, the financial statement should include historical financial data, and a consolidated projection for the entire operation as well. The financial projection of the bio-gas plant should be disaggregated for the evaluator to assess the viability of the project on a stand-alone basis.



## 6. Commercial Plan

The Commercial Viability Plan shall be divided in two main sections. The first section shall assess the feasibility of the project on its own merits, excluding any other activities from the company. The second section shall provide all necessary information to demonstrate the commercial viability of the company as a whole.

### 6.1 Biogas Project Commercial Viability Plan:

This section shall demonstrate that the project is commercially viable.

For this purpose, the Study shall provide the following information to AEPC:

- Cost and Revenue data:
  - Costs:
    - Capital investment costs (biogas plant and ancillaries)
    - Construction labour costs
    - Leasing costs (if required)
    - Insurance costs
    - Operational and maintenance costs
      - Labour
      - Water
      - Services
      - Transport of waste or fertilizer
      - Maintenance and replacement parts
      - Other
  - Revenue streams:
    - Selling of electricity to NEA if PPA with NEA
    - Connection tariff to biogas grid: if biogas is sold to the nearby community or industries, details on potential biogas grid connection tariffs shall be provided. Whenever biogas is sold to the nearby community, a justification for the tariff selected shall be provided on the basis of an analysis of the community's household income. The tariff shall be agreed with the community and set in such a way to ensure that the poorest households do not get excluded from the energy supply. Any records of meetings with the community or industries where negotiations take place shall be included in the appendix.
    - Biogas monthly fees: as above.
    - Connection tariff to electricity grid: if electricity is sold to the nearby community or industries, details on potential electricity grid connection tariffs shall be provided. Whenever electricity is sold to the nearby community, a justification



for the tariff selected shall be provided on the basis of an analysis of the community's household income. The tariff shall be agreed with the community and set in such a way to ensure that the poorest households do not get excluded from the energy supply. Any records of meetings with the community or industries where negotiations take place shall be included in the appendix.

- Electricity monthly fees: as above.
  - Fertilizer sales: if fertilizer is to be sold to the nearby farms or the market, the pricing strategy shall be described here and compared to other fertilizer products in the market.
- Cash flow statement
  - Key financial indicators: (Debt Service Coverage Ratio, Debt to Equity Ratio, Current Ratio, NPV, Payback Period, ROE, IRR, etc.
  - Breakeven/Cost Benefit Analysis
  - Sensitivity analysis (to include impact from rupee depreciation, inflation, fixed cost overrun, increase in operating cost, dip in sales price, increase in financing cost, and any other variables that the developer may consider to influence the project). This should be supported by realistic assumptions.
  - Financing Terms - Loan repayment period, interest rate
  - Applicable tax rate

### ***Market Study for the Biogas Plant***

#### **Target Market**

The size of each market segment should be established, along with forecasts for growth or decline, and a description of potential customers for each segment should be identified. For instance, if slurry is to be sold as fertilizer, the surrounding agricultural sector should be evaluated to determine their willingness to buy; if biogas is to be sold for cooking and lighting purposes, or electricity sold as a commodity, a consultation with the local community shall be carried out. If there are nearby industries that could benefit from heat energy from the biogas plant, they may also be targeted.

#### **Pricing**

The price charge for electricity, biogas, slurry as fertilizer, etc., should be determined in this section and used in the commercial viability analysis, explaining the rationale followed based on competitor's prices, perception of quality-price relationships by customers, production costs and overheads, distribution chain and added value at each stage, etc.

Prices for each of the products listed above from the biogas plant should be established carefully, considering not only profit rates but also favourable rates for consumers, and ensuring that access to energy from the poor is not hindered.



## Market Trends

Recent changes and future predictions shall be analysed here, accounting for demographic changes, economic and legislative factors that may have implications on the organisation's revenue stream. The organisation's plan to adapt to future demand shall be clearly outlined here.

## Profile of Competitors

Any potential competitors shall be identified in this section, including what advantages or disadvantages the organisation has compared to them. For instance, if there is another large biogas plant in the vicinity feeding electricity to the grid this may affect the characteristics of the network and the plant's ability to export electricity, or if lower rates are offered by other means such as diesel generators or other nearby plants this may affect the final price set for electricity.

Regarding fertilizer, slurry rates may compete against chemical fertilizers or other biogas plants so these should be accounted for when determining revenue from fertilizer sales.

The above will assist the organisation in establishing its competitive advantage, which shall be stated here.

## Benefits to Clients

This section shall highlight what are the main benefits to potential customers. For example, slurry from a biogas plant may be cheaper and increase crop yields, or there could be other benefits such as health benefits as a cleaner fuel compared to fuelwood is provided, or environmental as methane is being captured avoiding its GHG effect, or reducing the impact of load shedding by generating electricity off-grid.

The number of beneficiaries impacted by the project should be clearly stated here.





## **6.2 Company Commercial Feasibility:**

The study shall demonstrate the viability of the Developer's Company as a commercial entity, as even if the biogas project is shown to be viable, if the commercial viability of the whole company cannot be proven, the sustainability of the project will be compromised.

In order to do this, the company shall provide comply with the following requirements:

- Names and addresses of all shareholders/promoters
- Names of businesses (existing) that the promoters are currently involved with.
- Annual turnover, profitability margins, repayment track record of existing loans (if applicable)
- Names of bank/s that is being used by the promoters for their existing business (loan amount and equity) and for the proposed project.
- Photograph and citizenship of the key developer/s
- Certificate of registration (renewal) and PAN and /or VAT
- Income Tax receipt of the latest FY
- Latest audited / provisional financial report
- Financial plan with projections for entire tenure period of the loan



## **7. Project Risk Assessment**

This section shall analyse the main risks affecting the project, state the potential consequences, mitigation measures that will be put in place, who is responsible for the implementation of the mitigation measures and a timescale proposed for addressing those risks.

The Consultant shall consider all types of risks that may affect the project, be these financial, technical, commercial, environmental or social, during all stages of the project.



## 8. Appendices

This section shall be used to provide any other documentation that the project proponent may consider to include to support its DFS. This documentation may include letters of agreement with the financial sector, municipalities, memorandums of understanding, data to support the financial DFS, detailed calculations, or any other information that the Consultant may deem relevant or has been referred in the sections above.

### Optional Design Information: Drawings, Diagrams, Plans and Reports

In addition the project proponent may provide additional optional information to support or clarify their design. This may include drawings showing the limits of the Project Site and the limits of construction and areas to be avoided during construction; roadways and traffic circulation; parking areas; site drainage; storm water management facilities, and landscaping. Drawings shall depict the accommodations made for possible future expansion of the Project. The Consultant may include additional drawings.

- Plant layout
- Complete process flow diagram for the entire Project
- Listing and location of all gas pipelines, flow control and quality/quantity monitoring devices
- Listing and location of all generated power lines and related control/conditioning equipment
- Listing and location of all waste heat control and quality/quantity monitoring devices
- Environmental and Social Safeguard measures
- Conceptual grading and drainage plan
- General description of Utilities