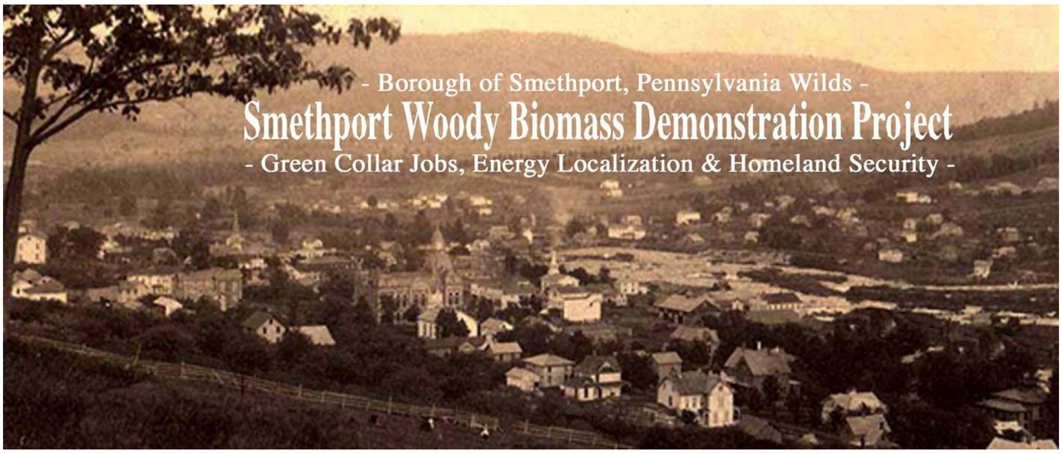
Municipal Energy Services Agency (MESA)

Technical Report



Smethport Woody Biomass

Smethport Woody Biomass Demonstration Project

DRAFT

Bad Vilbel, 02.12.2009

LAHMEYER INTERNATIONAL

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Prepared for
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I Executive Summary

Will be implemented after discussions.

II Project Introduction

II.A Project Background

To establish Smethport as an energy independent borough with an affordable, locally controlled, and sustainable energy supply, the Municipal Energy Service Agency (MESA) on behalf of the Borough of Smethport (Borough) sought a Technical Consultant to provide a feasibility study on woody biomass utilization in Smethport.

The study includes an assessment of the opportunities, as well as recommendations to deploy a Combined Heat and Power (CHP) production facility fueled by woody biomass feedstock to supply a portion of the power and heating needs of the Borough. To take advantage of the upcoming reconstruction of the drinking water system, it is envisaged that the district heating network will be installed simultaneously.

The Smethport Woody Biomass Demonstration Project specifically called for European expertise in wood-fired CHP plants and district heating systems. To meet the requirements of the assignment and to form a team of specialized consulting and engineering companies, Lahmeyer International, as an independent engineering consultant, teamed up with GEF Ingenieur AG and Seeger Engineering AG, two other established companies from Germany. Knowing that a European technical approach cannot simply be transferred to Smethport, Pennsylvania, the Team was completed with O’Brien & Gere, a well-known consultant from the United States.

II.B Project Start

With the start of the project in August 2009 after commissioning, open points of the “project needs list” were clarified. The projects needs list was given to Smethport by the Team after the Interview in April 2009.

Additional and missing data for the Feasibility Study was gathered by the Team during three days on-site in Smethport in August 2009. In order to make these three days as effective as possible for the project, in advance of the trip the Borough – in consultation with the Team – organized many meetings and appointments.

Since the Borough would like to take advantage of the upcoming reconstruction of the fresh water system by installing the district heating network simultaneously with the installation of the water pipes, the Team also secured a description of the project properties and streets affected, and a rough schedule for the whole activity.

At the end of the site visit, the Team and the Borough determined boundary conditions for the Base Case Scenario based on the findings during the site visit and the Borough's decision concerning the reconstruction of the fresh water system.

III Borough Conditions

The Borough is a municipality with a population of about 1,650 located in McKean County in northwest Pennsylvania. Smethport is located in the center of the Pennsylvania Wild's "wood basket" represented by 5.2 million acres of forest land which includes the Allegheny National Forest, DCNR State Forests, and considerable private forest ownership. In addition to its location in the midst of the great forest lands of northwestern Pennsylvania, Smethport is unique as the only municipality in the twelve-county area comprising the Pennsylvania Wilds Region to supply electricity to the residents of its Borough and surrounding areas through a Borough-owned electric utility company

III.A Borough Utility Conditions

III.A.1 Electricity

Since the 1920s, the Borough has owned and operated its own electric company. To this day, it remains unique in the twelve-county "Pennsylvania Wilds" region as the only municipality that runs its own power company – servicing its own transmission lines and purchasing electricity from outside generators.

The Borough is currently serviced by a 12.47kV loop service with the point of connection on the East side of the Borough in proximity to the intersection of RT 6 and Railroad Ave. (see Figure 2.1). The loop configuration connection of the First Energy 12.47kV lines provides a flexible utility source for the Borough.

The historical Borough electrical demand is 2.9MW peaking in the early summer period. The average Borough load is estimated to be 2.2MW

III.A.2 Water

The Borough's 100-year-old water system is in desperate need of replacement. Old iron pipes, and even some wood piping, run underground throughout the community. The Borough's ground water is supplied by three wells on Ralph Street.

The water system is owned by the Boroughand includes two (2) groundwater wells, mains ranging in size from 2-inches to 12-inches in diameter, the 500,000 gallon Fulton Street Storage Tank, and three (3) pressure reducing valves (PRV). The Borough and the Borough of Smethport Authority (Authority) are in the process of transferring the water system from the Borough to the Authority.

The main problems in the water distribution system include insufficient pressure at the School Complex and in the northwestern part of the system, deteriorating lines on Main Street, lack of fire service, high unaccounted for water, PRV operational problems, and lack of line valves. Additionally, the Borough has recently discussed possible upgrades to the water plant facilities. The price tag to rebuild the system is currently estimated at $20 million.

III.A.3 Sewer

The Authority operates a Wastewater Treatment Plant located on the East side of Borough at E Water Street Ext. The WWTP has a treatment capacity of 0.75 million gallons per day (mgd). The sewer lines range from 18-inches to 4-inches. The location of the WWTP and the sewer system are depicted in Figure 2.1. The system is combined sewer overflow, which combines both stormwater and sanitary water though piping.

III.A.4 Natural Gas

The utility Natural Fuel Gas Company provides Smethport, PA with Natural Gas (NG). The National Fuel Gas Distribution Corporation sells or transports natural gas to nearly 731,000 customers in western New York and northwestern Pennsylvania. In Smethport, the NG service is located on the west side in proximity to the water wells.

IV Project Alternatives

IV.A Modules Feasibility Study

IV.A.1 Heat Demand Evaluation

IV.A.1.1.1 Existing Heat Demand

After the interview in Smethport in April 2009, the Team gave the Borough the advice to create a masterlist including the heat demand and additional important data of all properties of the Borough as the basis for the feasibility study, and made suggestions for the content of this masterlist.

The origin for this masterlist was an existing Excel spreadsheet containing the data from replies to a survey that was carried out in the Borough of Smethport some years/month before the project start. The response rate was high with around 435 replies. This origin masterlist is populated with a multitude of information including the property owner, living square footage, fuel type, furnace type and size, annual fuel consumption, and information related to a second furnace if applicable.

The Borough and the Team agreed that data related to the remaining properties that did not reply to the survey – and relevant information like heating capacity and fuel consumption for the single property – would not be obtained via a second survey, but by assembling different data and information sources with direct access by the Borough instead.

It was decided that the masterlist will be assembled by the Borough and that a minimum living square footage and utilization of the single property would be established by the Borough. It was also decided that integration between this masterlist and an already existing GIS-model of Smethport[1] will be completed by the Borough prior to the conceptual design of the district heating network, so that the data for each single property can be assigned to the properties position on the GIS-model by the team.

On the basis of the known course of the fresh water system, the Borough made the first selection of properties which are planned to be connected to the district heating network in the future.

The final version of the masterlist[2] contains information and data for 899 properties in Smethport with a single heating facility. The properties also had information related to their usage (Residential, Commercial, Office, Church, Nursing home, In-

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[1] Different GIS-files from Gannet Fleming and Mc Kean County.
[2] File "SmethportBioMass_mdb_ver.4.3.mdb", containing table "Address_Pts" and table "HeatLoad_3_1". Table "HeatLoad_3_1" contained 1,052 lines, 1,043 AID numbers and for 899 lines with information for square footage.

dustrial). For 309 properties the masterlist contained more detailed information for the single property as a result of the survey.

This final masterlist was taken as basis for the heat demand evaluation.

As first step of the heat demand evaluation, for each of the 309 properties with detailed information, the annual heat demand was generated on the basis of the sum of the known fuel consumption (primary and secondary) and assumptions for the efficiency of the boiler (primary and secondary). As a function of the usage the 309 properties were pooled in usage groups.

As next step for each usage group mean specific values for the annual heat demand were generated. The specific values for all usage groups can be found in **Table IV.A.1-1**.

For all 899 properties as minimum information next to usage and AID code (necessary data for GIS model) the heated square footage was given. To calculate the annual heat demand of the remaining 590 properties (899 properties minus 309 properties with detailed information from survey) the heated square footage of the single property was multiplied with the mean specific value for the annual heat demand of the appropriate usage group.

The calculated annual heat demand of all 899 properties for heating and domestic hot water was 40,700 MWh per year.

The heating capacity for each of the 899 properties was investigated on basis of specific nominal heat load hours in accordance with the German VDI 2067 standard and the calculated values for the annual heat demand. The specific values for all usage groups can also be found in **Table IV.A.1-1**.

The calculated maximum heating capacity of all 899 properties for heating and domestic hot water was 22.2 MW.

Table IV.A.1-1: Characteristic values of usage groups

Usage Group	Number	Spec. annual heat demand	Nominal load hours
	[-]	[kWh/m²]	[h/a]
Residential	278	200	2,000
Commercial	8	120	2,000
Office	15	200	1,700
Church	5	140	500
Nursing home	1	330	2,500
Industrial	2	60	2,000

The calculations and outcomes of the heat demand evaluation could be found in file “HeatLoad_5_1 20090925a.xls” which afterwards was taken as the basis for the distribution system investigation.

Table IV.A.1-2: Major outcomes of heating demand evaluation

Number of Properties	899
Annual Heat Demand	40,700 MWh/a
Maximum Heating Capacity	22.2 MW

IV.A.1.1.1.1 Future Heat Demand

Since no indications of major changes for the heat demand were given (*e.g*. Borough forecast for the next 10-25 years) the calculated values for annual heat demand and heating capacity were assumed to be constant for the purpose of the feasibility study.

IV.A.2 Distribution System Investigation

IV.A.2.1 Generate Hydraulic Flow Model

One important component for a pipeline-bound heat supply system is the design of the distribution network. The dimensioning of the distribution network depends on the position and heat load of the consumers. Therefore, the first step is the analysis of the heat demand. Thus, a heat density map was developed.

As basis of the heat density map (cp. **Figure IV.A.2-1** and **Annex IV.A.2.1-1**) the heat demand evaluation from Lahmeyer International was used. In the heat density map the heat density [BTU/hour per foot^2] is illustrated in graduated tones. The darker colors represent higher heat densities.

Because of the map size, the heat load of every single building is only presented in **Annex IV.A.2-1**. There, every building is illustrated as a small circle and located on the basis of its x- and y-coordinates. The different circle-sizes represent the dimension of the heat load.

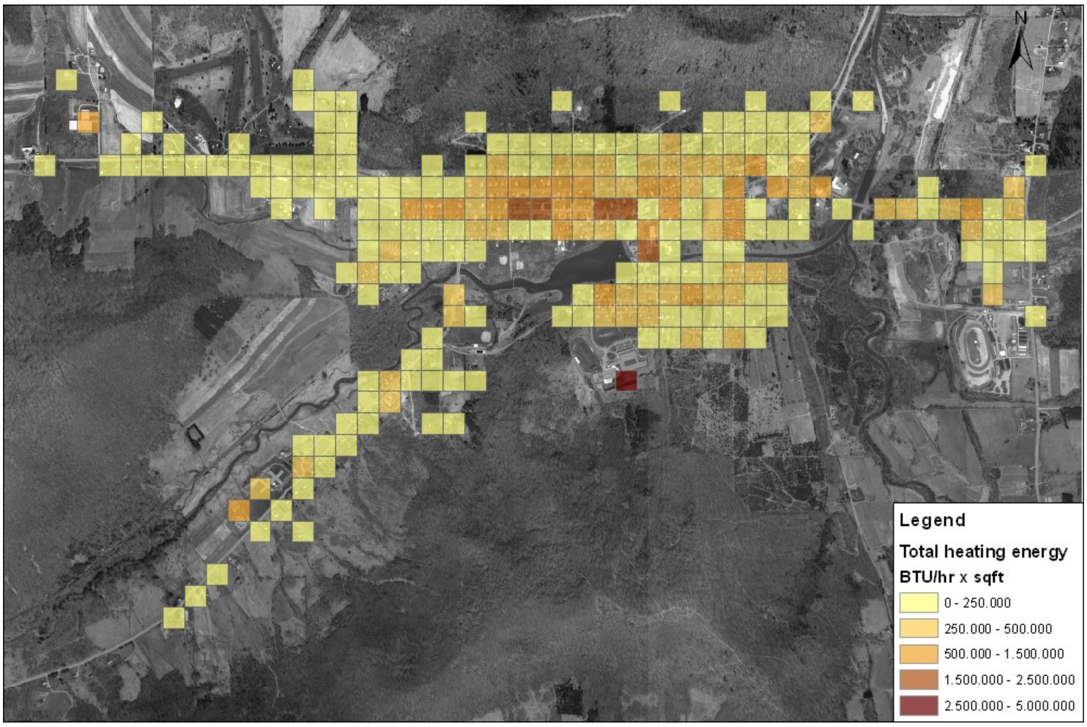

Figure IV.A.2-1: Heat density map

After establishing the location of the biomass-CHP-plant at the old industrial waste-land north-east of Smethport (SITE 3) as the only location for the heat generation, the pipeline route follows the highest heat density. Another input requirement in this case is the distribution of the planned new fresh water system. With the installation of a new fresh water system in the old distribution route, the road surface will already be scarified. That will decrease the first costs for the construction of a district heating system.

Before the analysis of the heat demand the examined area – illustrated in the heat density map (cp. Figure IV.A.2-1) as squares with colors from yellow to brown – was limited. The limitation factors for the predefined area under investigation were:

- Only areas near the given course for the regeneration of the fresh water system
- Only areas which include county buildings
- Only areas with a total heat energy density bigger than 250,000 BTU/hr x ft2

If the buildings were arranged close to the district heating pipeline route, they were also integrated in the following considerations even if they had a lower heat density than 250,000 BTU/hr x ft^2.

After the selection of the predefined area under investigation, the primary 899 buildings decreased to 709 buildings.

For the generation of the hydraulic flow model two variants were examined, a worst case and a best case variant:

- Worst case: 100% of the heat load of the county buildings, school, and ten largest consumers, plus 25% of the heat load of all other buildings in the predefined area under investigation

- Best case: 100% of the heat load in the predefined area under investigation

The heat demand for consumers in the area around the district heating pipeline route was determined and as a worst case scenario, valuated with a connection probability factor of 25%. That means it was assumed that about 25% of the total heat demand of the surrounding consumers could be connected to the district heating system. This assumption excluded the public buildings which would definitely be connected to the district heating system (connection probability factor of 100%). Also the ten largest consumers were valuated with a connection probability of 100%, so that the district heating system will have a worst-case scenario basic load when it is put into operation.

Mostly the reality will be between the two variants, a 100%-connection-probability (best case) will be rarely be achieved. The construction of a district heating system normally starts with a similar state to the worst case and aspires towards the best case. That means the worst case scenario is the initial stage and the best case scenario is the final ambition stage. The dimensioning of the district heating pipes has to run at the best case scenario but must also satisfy the worst case scenario.

In addition to the above named terms (following the highest heat density and the distribution route of the fresh water system) an attempt was made to connect the public buildings and the ten largest consumers as corner pillars of the future district heating system. With the exception of Smethport Specialty, all major consumers are arranged close to the designated district heating pipeline route.

In the above-described modality a district heating distribution network was generated and is presented in Figure IV.A.2-1**.** The next step was the determination of the pipe sizes and operation parameters.

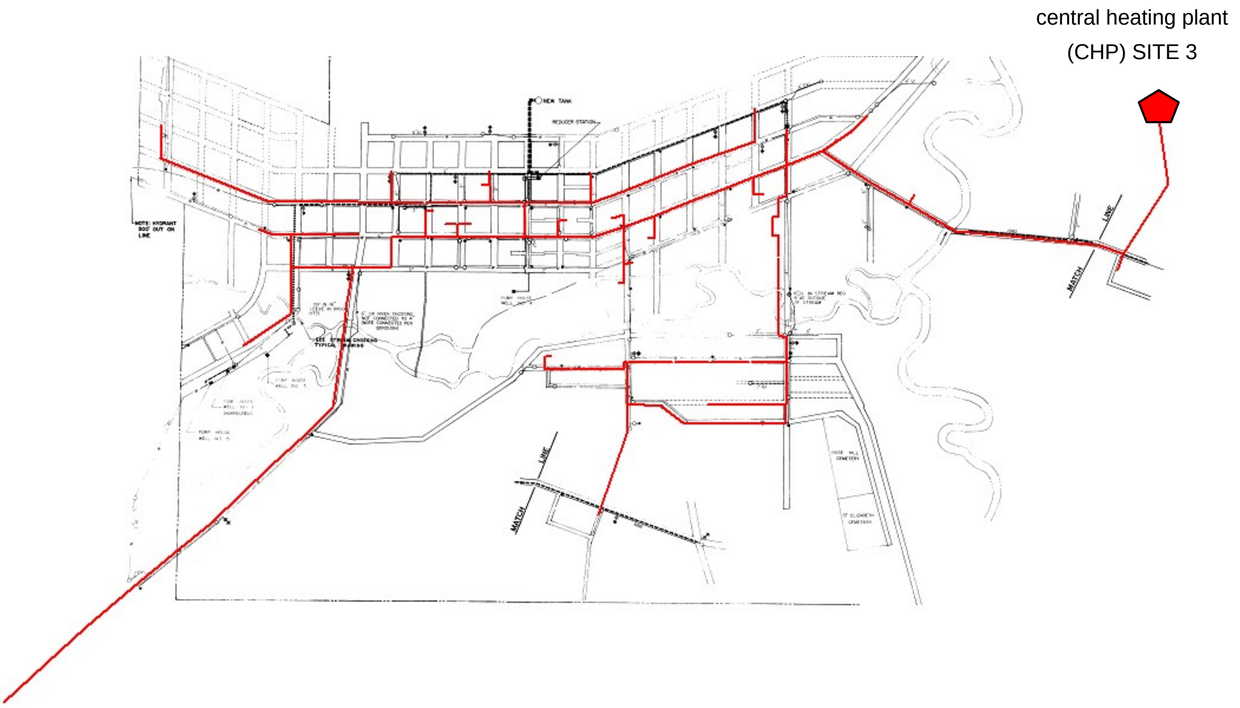

Figure IV.A.2-2: District heating distribution network

Other important results of the heat density analysis, required for the design of the heat generation plant, were the total heat demand and the load duration curves (worst case and best case).

The heat demand for the worst case is composed of:

• County buildings and school	max. load energy	9,088,000 BTU/hr x 100% 15,820 x 10^6 BTU x 100%
• Ten largest customers	max. load energy	8,886,000 BTU/hr x 100% 11,102 x 10^6 BTU x 100%
• Rest of the predefined area	max. load energy	44,763,000 BTU/hr x 25% 87,301 x 10^6 BTU x 25 %

These values were multiplied with a simultaneous building demand factor of 0.8 and including 2% heat loss the maximum load amounts about 23,795,000 BTU/hr and the energy 56,058 x 10^6 BTU (incl. 15% heat loss).

The heat demand for the best case is composed of:

• County buildings and school	max. load energy	9,088,000 BTU/hr x 100% 15,820 x 10^6 BTU x 100%

• Ten largest customers	max. load energy	8,886,000 BTU/hr x 100% 11,102 x 10^6 BTU x 100%
• Rest of the predefined area	max. load energy	44,763,000 BTU/hr x 100% 87,301 x 10^6 BTU x 100%

The values for the best case were also multiplied with a simultaneous building demand factor of 0.8 and including 2% heat loss the maximum load amounts about 51,200,000 BTU/hr and the energy 131,355 x 10^6 BTU (incl. 15% heat loss).

In **fig. 3.3-3a** and **3.3-3b** the annual load duration curve for the worst and best case scenarios are shown.

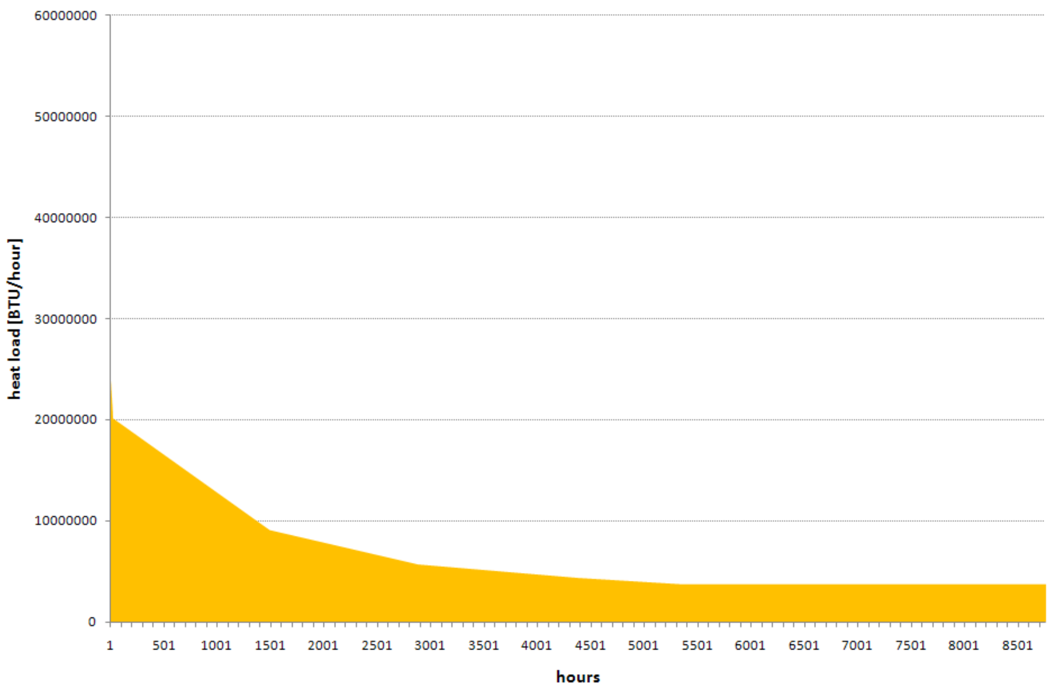

Figure IV.A.2-3: Annual load duration curve (worst case)

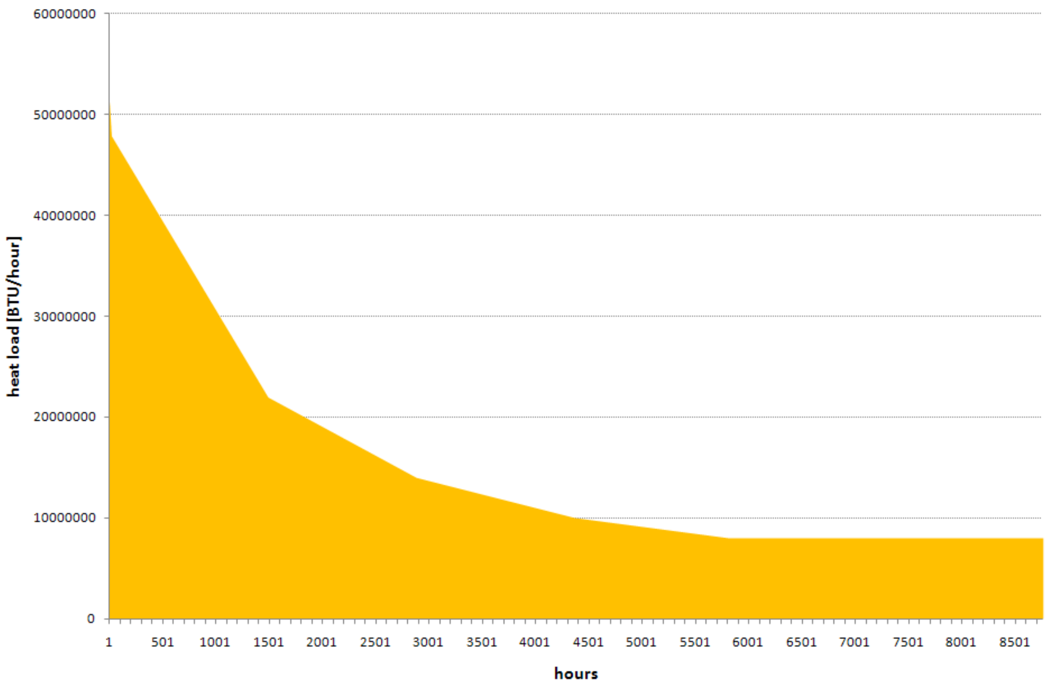

Figure IV.A.2-4: Annual load duration curve (best case)

IV.A.2.2 Hydraulic Flow Calculation

After the heat demand analysis and the design of the heat generation plant, the parameter for the dimensioning had to be defined.

The pipe sizes are determined from the maximum mass flow, which in turn depends on the temperature difference. By dimensioning the pipe diameters it was assumed that the maximum mass flow occurs at the maximum heat load.

The maximum heat load of the district heating system is from the sum of the heat loads of every single consumer multiplied with a simultaneous building demand factor. The simultaneous building demand factor depends on the number of connected buildings in the district heating system. Assuming a simultaneous building demand factor of 0.8 there is sufficient safety included.

To simulate the load distribution as accurately as possible, in addition to the public buildings, the ten largest consumers were integrated in correct position into the district heating distribution network model. The rest of the consumers were summarized in sections and integrated as one consumer for every section (total heat demand of two to six squares was summarized and attached into the network model after the summarized squares in flow direction). A more detailed assimilation doesn't make sense since there is no information on which buildings will be connected to the future district heating system.

A detailed breakdown of all consumers (corresponding to the best case scenario) is presented in **Annex IV.A.2-2**. The total connected load of 62,747,084 BTU/hr, multiplied with a simultaneous building demand factor of 0.8 (including 2% heat loss) represents the best case scenario.

With the allocation of the consumers and the multiplication with the simultaneous building demand factor of 0.8, a load distribution (incl. heat losses of about 2% of the maximum heat load) for the district heating system has arisen:

- Worst case: maximum load approx. 23,795,000 BTU/hour
- Best case: maximum load approx. 51,200,000 BTU/hour

Besides the load distribution of the district heating system some other parameters determine the dimensioning of the pipe diameters. Fundamental for the dimensioning of the pipe sizes is the temperature difference between supply and return temperature. The return temperature for the worst and best case scenarios is 140°F (existing heating systems are often not state-of-the-art, preferably the return temperature should be kept as low as possible). The supply temperature is dependent on the outdoor temperature and, thus, on the load situation. In **Fig. 3.3-4** an example of such an operation temperature curve is shown. At an outdoor temperature of about 60°F only the heat demand for the domestic hot water preparation must be provided.

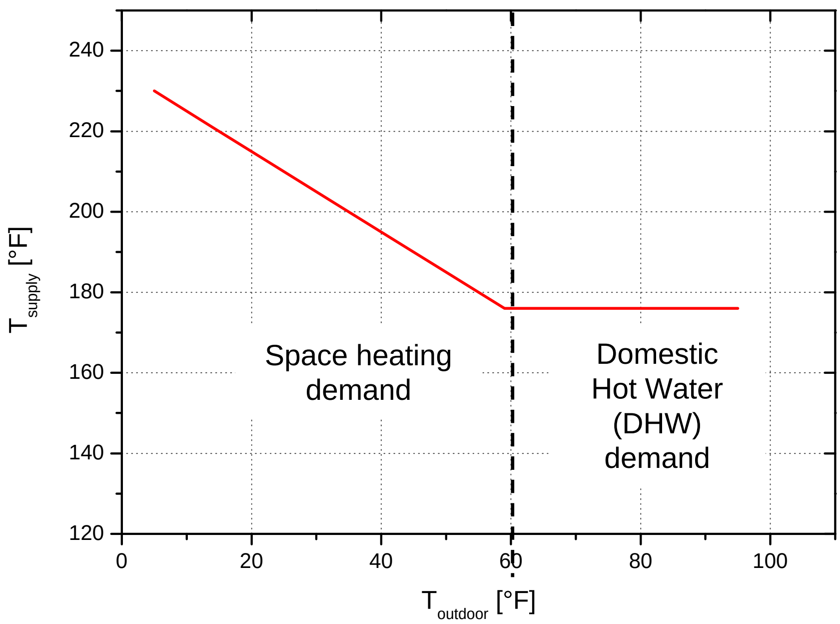

Figure IV.A.2-5: Supply temperature depending on the outdoor temperature

At the start of the operation the district heating system equates to the worst case. Experience has shown that the best case cannot be achieved right from the start, since the heat users mostly will – due to economical reasons – be connected to the system when need to replace their heating equipment. Nevertheless the pipe diameters will be sufficient to accommodate the final state of the district heating system. The goal was to provide the worst case situation with a lower supply temperature of about 194°F and raise the supply temperature with an increasing number of consumers to a maximum of 230°F.

The maximum supply temperature should be utilized only a few hours per year because of a more efficient energy supply with reduced heat losses.

The dimensioning of the pipe diameters were run at a maximum heat load (best case) and a maximum supply temperature. The operation temperature will be adapted in this way so that the maximum mass flow occurs at the maximum heat load.

It should be noted that SITE 3 is the only location for the heat generation – containing the plants for base load and peak load at one location.

Another requirement to the pipes was that the maximum specific pressure loss does not exceed 0.685 PSI/in (critical value for an efficient district heating development).

Overview of the dimensioning parameters:

- Simultaneous building demand factor 0.8
- Supply temperature 230°F
- Return temperature 140°F
- Maximum specific pressure loss 0.685 PSI/in
- Wall roughness correction factor 0.004 in
- Length correction factor 1.10

The wall roughness correction factor describes the pressure loss due to the friction force of the pipe wall. The length correction factor considers the additional pressure loss which is caused by branches, fittings, curved parts, and so on. It is an empirical value.

The results of the dimensioning are summarized in Section 'IV.A.2.3 Recommendation and Outcomes'.

IV.A.2.3 Recommendation and Outcomes

District heating distribution system:

The dimensioning was made for the best case scenario at the maximum heat load. That sets the possibility of a district heating supply for all other heat load scenarios, including worst case, since this load situation will cause the highest mass flow of supply water. The supply temperature can be adapted and optimized according to every single heat load scenario.

In Table IV.A.2-1 the required pipe diameters are presented in dependence to their length.

Table IV.A.2-1: Dimensioned pipe diameters in dependence to their length

Pipe diameter	Length of pipeline [ft]
1''	1,024
1.25''	340
1.5''	3,385
2''	6,181
2.5''	4,275
3''	4,830
4''	7,911
5''	2,731
6''	1,065
8''	2,711
10''	5,021
Total	**39,472**

The total pipeline length of about 39,500 ft contains the length of the main transmission pipeline and the length of the distribution pipelines. It does not contain the length of the sub-distribution pipelines and the house service connections. Since most of the consumers were assimilated as summarized consumers in the network model, the sub-distribution pipes as well as the house service connections are not included in the network model and therefore they could not be dimensioned. For the allocation of the sub-distribution diameters and the house service connections an assumption was required.

The main distribution network is shown in Figure IV.A.2-1. The pipe diameters are illustrated in graduated tones.

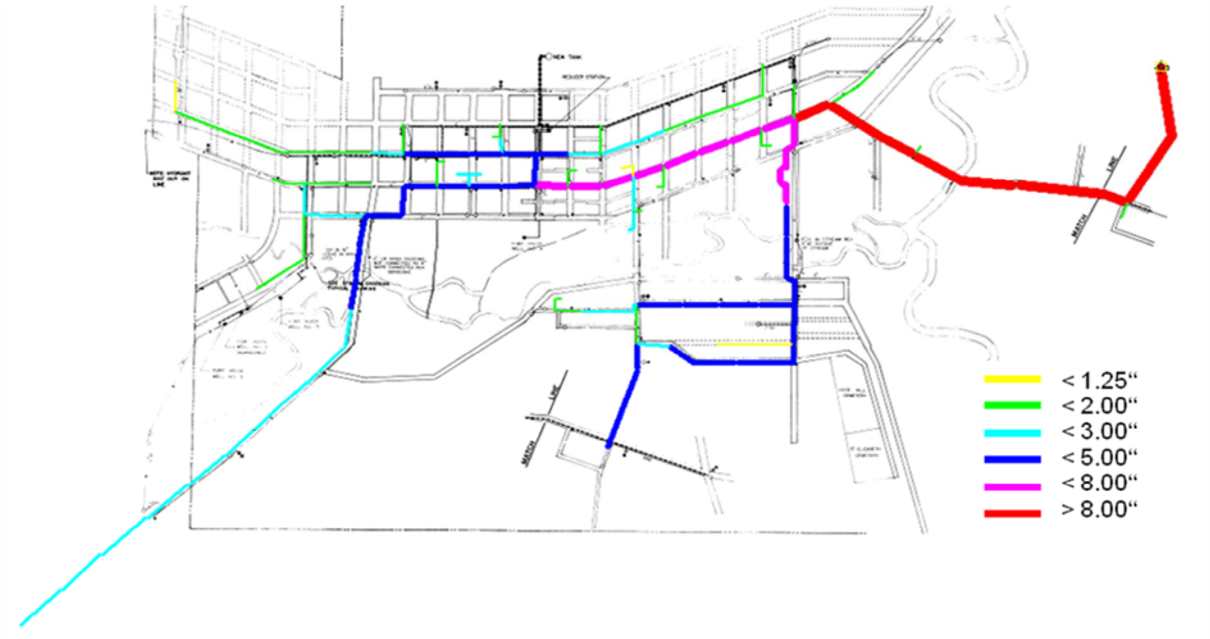

Figure IV.A.2-6: Pipe diameters of the main distribution network

The length of a house service connection averages 50 ft. In the predefined investigation area there is a total of 709 buildings, including ten county buildings and the ten largest customers. The county buildings and the major customers each have a house service connection provided in the network model, so 689 buildings remain.

689 x 50 ft = 34,450 ft 1’’ house service connections

Additionally it was assumed that besides the house service connections, one-third of the 689 buildings need sub-distribution pipelines. Since it concerns mainly single-family houses the average diameter of a sub-distribution pipeline is 1.25’’ with an average length of about 200 ft.

1/3 x 689 x 200 ft = 45,900 ft 1.25’’ sub-distribution pipelines[3]

The estimated length of the house service connections and the sub-distribution pipelines are related to the best case. At the worst case scenario only 25% of the heat load of the remaining 689 buildings (excluding the ten county buildings and the ten largest customers) in the predefined area will be connected to the district heating system. So the length of the house service connections was reduced to a total of 8,610 ft (25% of the best case scenario). The length of the sub-distribution pipelines was not reduced at the worst case scenario because they will be built in the course of the replacement of the fresh water system.

Table 3.3-3 gives an overview of the pipe sizes and length for the district heating distribution network for the worst and best case scenarios. The investment costs for the distribution network were calculated with the specific costs in dollars per foot. In contrast to normal pipe construction costs, a part of the excavation costs

[3] Hint: The transport capacity is proportional to the square of the diameter!

can be deducted because of the combined hauling of the district heating pipes and the pipelines for the fresh water system. In the table below (cp. **Table 3.3-2**) of pipe construction costs, it was assumed that the excavation costs decrease about 30-40%. The excavation costs comprise approximately 50% of the total pipe construction costs, so the normal pipe construction costs decrease about 15-20%.

Table IV.A.2-2: Investment costs (worst case)

Pipe diameter	Length [ft]	Specific costs [$/ft]	Costs for pipe work [$]	Excavation Costs [$]	Investment Costs [$]
1''	9,634	125	722,550	481,700	1,204,250
1.25''	46,240	125	3,468,000	2,312,000	5,780,000
1.5''	3,385	130	270,800	169,250	440,050
2''	6,181	140	525,385	339,955	865,340
2.5''	4,275	165	427,500	277,875	705,375
3''	4,830	200	579,600	386,400	966,000
4''	7,911	265	1,265,760	830,655	2,096,415
5''	2,731	290	477,925	314,065	791,990
6''	1,065	305	197,025	127,800	324,825
8''	2,711	360	590,998	384,962	975,960
10''	5,021	475	1,446,048	938,927	2,384,975
Total	**93,984**		**9,971,591**	**6,563,589**	**16,535,180**

Table IV.A.2-3: Investment costs (best case)

Pipe diameter	Length [ft]	Specific costs [$/ft]	Costs for pipe work [$]	Excavation costs [$]	Investment costs [$]
1''	35,474	125	2,660,550	1,773,700	4,434,250
1.25''	46,240	125	3,468,000	2,312,000	5,780,000
1.5''	3,385	130	270,800	169,250	440,050
2''	6,181	140	525,385	339,955	865,340
2.5''	4,275	165	427,500	277,875	705,375
3''	4,830	200	579,600	386,400	966,000
4''	7,911	265	1,265,760	830,655	2,096,415
5''	2,731	290	477,925	314,065	791,990
6''	1,065	305	197,025	127,800	324,825
8''	2,711	360	590,998	384,962	975,960
10''	5,021	475	1,446,048	938,927	2,384,975
Total	**119,824**		**11,909,591**	**7,855,589**	**19,765,180**

This cost estimate assumes that pre-insulated bonded pipes will be installed as the district heating distribution system. Pre-insulated bonded pipes are one of the most flexible, cost effective, and common types of piping systems. The pipes are pre-insulated in the factory and consist of a steel medium pipe and a plastic jacket pipe. The insulation between the two pipes is made from polyurethane (PUR) heat insulation foam, a rigid material that bounds the outer jacket with the inner medium pipe. The bonding PUR insulation also includes a leak detection system.

The most important limitation of the pipe is its maximum temperature restriction of 285°F, which minimizes the aging of the PUR foam caused by exposure to the high temperatures. The pipes are buried at frost-free depth in an open trench. After the laying of the pipe with a length of 15-30 ft, the single pipes are connected through welding. Afterwards the polyethylene (PE) jacket pipes are connected with shrinking bushings. Finally, the space between the medium pipe and the bushings is foamed in place. After all of the steps are complete, the trench is filled with sand and compressed to bury the pipes. When the pipes are completely buried, the trench is further filled and prepared for the desired surface. (See: A. Zhivov; J. Vavrin; A. Woody; D. Fournier; S. Richter; D. Droste; S. Paiho; J. Jahn; R. Kohonen: *Evaluation of European District Heating Systems for Application to Army Installations in the United States*, Chapter 3.1.2 Paragraph 7. ERCD/CERL TR-06-20; US Army Corps of Engineers, Engineer Research and Development Center, Champaign (IL) and Washington (D.C.), July 2006)

In contrast to a steel jacket pipe or other systems, pre-insulated bounded pipes need no axial-compensation and no u-bends. The quality supervision during the construction phase is very important.

In addition to the investment costs of the pipes at the beginning of the project, there are annual costs for operation and maintenance (O&M). O&M costs are estimated to be 1.5% of the investment costs in accordance with the German VDI 2067 standard. As a result annual O&M costs are about **$248,000** for the worst case and **$296,500** for the best case.

Customer Interface:

The customer interface connects the district heating network with the heating system of the customer. It is the connecter between the house service connection and the consumer’s installation and provides the heat contractually regarding pressure, temperature, and volume flow to the consumer’s installation.

The main parts of the customer interface are:

1. District heating control for the secondary side
2. Control valve
3. Differential pressure control, flow rate control
4. Heat meter
5. Plate heat exchanger

In state-of-the-art district heating systems all these components of the customer interface installation are packaged into an assembled unit called "compact station" as the interface between the district heating system and the single house or property.

Both the district heating control for the secondary side and the control valve regulate the secondary system flow according to the ambient temperature. The differential pressure control and flow rate control are used to control the flow rate. Therefore, a certain flow rate limitation is fixed while differential pressure is variable. When differential pressure increases, the controller shuts according to its setpoint; similarly when differential pressure decreases, the controller opens. The heat meter is used both for billing and to control the flow rate. In most cases, the utility owns the heat meter while the customer owns the compact station. The plate heat exchanger is used to decouple the primary district heating distribution system from the secondary building side. This is important if the secondary building piping cannot bear up the relative high temperatures and pressures of the primary district heating side. (See: A. Zhivov; J. Vavrin; A. Woody; D. Fournier; S. Richter; D. Droste; S. Paiho; J. Jahn; R. Kohonen: *Evaluation of European District Heating Systems for Application to Army Installations in the United States*, Chapter 3.1.3 and the following. ERCD/CERL TR-06-20; US Army Corps of Engineers, Engineer Research and Development Center, Champaign (IL) and Washington (D.C.), July 2006)

The existing direct lighted or electrical domestic hot water preparation in the single houses will be replaced by a storage charging system. The storage charging system is a combination of a circulatory system and storage. While the circulatory water heater provides the basic load, the storage secures the hot water for use in peak-periods.

The costs for a storage charging system are comprised of installation, storage and the storage charge pump, connection to the distribution station, and regulation. A single-family house needs maximum storage of approximately 50 gallons, and a storage charging system for a single-family house costs approximately $3,500. That results in total costs of about **$2,370,160** for 689 single-family houses (best case scenario). In the worst case scenario only a quarter of the 689 houses will be equipped with a storage charging system. That results in costs of **$592,540**.

The storage charging system costs for the county buildings as well as for the major customers are as yet undetermined. The utilization of these buildings cannot be concretely identified, though it is assumed that the jail, the school, and the Bowman Health Center (county buildings) as well as Old Sena-Kean Manor and Lakeview Care Center are in definite need of domestic hot water preparation. The rest of the buildings need just partial a domestic hot water preparation (*e.g.* churches need no domestic hot water preparation). The hot water storage needs for county buildings and major customers are much larger than storage for a standard single-family house. The costs for the storage charging systems for the county buildings are estimated to be **$36,800** and for the major customers **$53,400**.

The investment costs for the compact stations (cp. **Annex 3.3-3**) are estimated on the basis of a cost function which defines that compact-stations smaller than 68,300 BTU/hr costs $4,490. The costs for the bigger compact-stations rise in dependency to the connection load.

The investment costs for all compact-stations (best case) is **$3,394,180**. The investment costs for the compact-stations in the worst case scenario decrease to 25% of the miscellaneous customers and amount to **$1,094,520**, but also contain the complete costs for the county buildings and major customers.

Summary:

A summary of the first costs for the district heating distribution system, the domestic hot water preparation and the building substation is given in **Table IV.A.2-4**:

Table IV.A.2-4: Summary of the first costs

Investment costs	Best case [$]	Worst case [$]
DH distribution system pipe construction	19,765,180	16,535,180
DHW preparation storage charging system	2,370,160	592,540
Customer interface compact-station	3,394,180	1,094,520
Total	**25,529,520**	**18,222,240**

Further investment costs – as part of the distribution system – must be considered for the pressure maintenance and for the installation of the mains-operated circulating pump (cp. **Table IV.A.2-5**). The investment costs for safety equipment like main isolation valves are included in the specific costs for pipe construction. The costs for a monitoring system were considered together with the cost estimate for the mains-operated circulation pumps.

Table IV.A.2-5: Further investment costs

Investment costs	Best case [$]	Worst case [$]
Pressure maintenance (pm):		
- pm for 14 x 10^6 gal	59,800	59,800
- pipes, pumps, overflow valve, regulation etc.	52,400	52,400
Mains-operated circulating pumps:		
- general costs	59,800	59,800
- pumps	112,200	89,700
- misc. machine technology	149,600	149,600
- process measuring and control technology	216,900	209,400
Total	**650,700**	**620,700**

Results of the hydraulic calculations:

After the dimensioning of the district heating distribution pipes, two hydraulic calculations at maximum heat load were run – one each for the worst and best case scenarios. The results are shown in **Table 3.3-5** and also in **Annex 3.3-4**.

Table IV.A.2-6: Results of the hydraulic calculations

	Worst case	Best case
Power entry [BTU/hr]	23,796,970	51,193,530
Peak power consumption [BTU/hr]	22,868,041	50,138,240
Heat losses [BTU/hr]	928,929	1,055,290
Peak mass flow [gal/hr]	53,164	68,503
Supply temperature [°F]	194	230
Return temperature [°F]	140	140
Outgoing pressure [PSI]	150	155
Return pressure [PSI]	43.5	43.5
Minimum differential pressure [PSI]	14.5	14.5

The heat losses for the peak load in the worst case scenario differ from the assumption made in section '3.3.1 Generate Hydraulic Flow Model'. There were assumed heat losses of 2%, but the calculation detected heat losses of about 4%. The best case scenario was in agreement. Because of the very low heat density in a widespread piping network with pipe sizes adapted to the best case scenario (causes small flow velocities) the heat losses in the worst case scenario exceeded the assumption of 2% (typical value).

As it is shown in **Table IV.A.2-6** the required nominal pressure level is PN16 (is consistent with 232 PSI).

Recommendation and Outcomes:

- The operation temperature should be kept at a low level to ensure a long lifetime of the piping system.
- The results of the dimensioning are only guide values. For concrete planning of the district heating distribution network, the dimensioning should be repeated with more detailed pre-settings.
- The specific pipe costs are average costs. The real costs can differ because of unforeseen difficulties in the streets.
- The cost estimate for the domestic hot water preparation – particularly for the major customers – is very vague. The demands of these buildings should be investigated more precisely in the next phases of the project.

IV.A.3 Conceptual Design of Biomass-CHP-Plant

The Borough intends to erect and operate a biomass combined heat and power (CHP) plant for the provision of a new district heating network. The optimum system configuration shall be proposed for the biomass CHP plant. The system dimensioning is includes providing the heat supply of the district heating network, as well as efficient operation of the biomass CHP plant.

IV.A.3.1 Basic Information

The dimensioning and the cost-benefit analysis of the different concepts for the biomass CHP plant are based on the following information:

Heat demand

The dimensioning of the biomass CHP plant is based on the outcomes of the Heat Demand Evaluation and of the Distribution System Investigation of the district heating network.

As a result two sorted heat load graphs were provided for the heat supply of the district heating network. The first heat load graph, representing the expected final stage (best case) of the district heating network, is applied for the dimensioning of the biomass CHP plant. The second one represents the minimum heat supply in the initial stage (worst case) of the operation of the district heating network. The latter is not relevant for the dimensioning of the biomass CHP plant, but for the suitability of the concept.

The annual mean value of the thermal losses of the district heating network was estimated as 15%.

The conversion factor for SI energy and power units to BTU equals 3,412,141 BTU/MWh respectively 3,412 BTU/kWh.

The characteristics of the two heat load graphs are as follows.

Table IV.A.3-1: Characteristics for best case heat load graph

Heat demand in final stage		
Maximum thermal output	14.99	MW
	51.19	Million BTU/h
Annual heat quantity of produced heat	38,510	MWh/a
	131.40	Billion BTU/a
Annual heat quantity of sold heat	32,725	MWh/a
	111.66	Billion BTU/a

Table IV.A.3-2: Characteristics for worst case heat load graph

Heat demand in initial stage		
Maximum thermal output	6.97	MW
	23.80	Million BTU/h
Annual heat quantity of produced heat	16,448	MWh/a
	56.12	Billion BTU/a
Annual heat quantity of sold heat	13,981	MWh/a
	47.71	Billion BTU/a

The sorted heat load graphs are attached in **Annex IV.A.3-A: Basic Information**.

<u>Supply and return temperatures</u>

As a result of the design of the district heating network, the following supply and return temperatures were provided. The value of the supply temperature varies depending on the thermal demand.

Table IV.A.3-3: Supply and return temperatures

Supply temperature		
12.83 … 14,99 MW	110	°C
43.82 … 51.19 Million BTU/h	230	°F
11.54 … 12.82 MW	105	°C
39.41 … 43.81 Million BTU/h	221	°F
8.96 … 11.53 MW	100	°C
30.60 … 39.40 Million BTU/h	212	°F
6.41 … 8.95 MW	95	°C
21.89 … 30.59 Million BTU/h	203	°F
5.57 … 6.40 MW	90	°C
19.02 … 21.88 Million BTU/h	194	°F
4.73 … 5.56 MW	85	°C
16.15 … 19.01 Million BTU/h	185	°F
0 … 4.72 MW	80	°C
0 … 16.14 Million BTU/h	176	°F

Return temperature		
0 … 14.99 MW	60	°C
0 … 51.19 Million BTU/h	140	°F

Fuel data

In the design of the biomass CHP plant, a provision is made for the combustion of natural wood chips in the wood furnace.

The quality of natural wood chips fluctuates depending on several factors including the type of wood, region of origin, season, and chipped parts of the tree. These result in strong variations of the water content, the ash content, the nitrogen content, the lower heating value (LHV), and the bulk weight of natural wood chips.

In the following the characteristics of the wood chips used as the basis of the design and dimensioning of the biomass CHP plant are defined.

The following table displays an exemplary elemental composition of natural wood chips according to our experiences.

Table IV.A.3-4: Typical elemental composition of natural wood

Element	Mass content
Carbon (C)	50,0 %
Oxygen (O)	44,0 %
Hydrogen (H)	6,0 %
Nitrogen (N)	0,5 %
Sulphur (S)	0,07 %
Chlorine (Cl)	0,02 %
Ash content (dry matter)	3,0 %

The particle size of the wood chips needs to be defined in order to determine the design of the type of storage, transport, and furnace for the wood chips. The classification of wood chips according the European pre-norm CEN/TS 14961:2005 is given below.

Table IV.A.3-5: Particle size classification of wood chips according the European pre-norm CEN/TS 14961:2005

Class	Main fraction > 80% of weight	Fines < 5 %	Coarse material maximum particle length
P16	3,15 mm ≤ P ≤ 16 mm	< 1 mm	max. 1 % > 45 mm, all < 85 mm
P45	3,15 mm ≤ P ≤ 45 mm	< 1 mm	max. 1 % > 63 mm
P63	3,15 mm ≤ P ≤ 63 mm	< 1 mm	max. 1 % > 100 mm
P100	3,15 mm ≤ P ≤ 100 mm	< 1 mm	max. 1 % > 200 mm

The recommended particle size of the wood chips is the class P63 acc. to CEN/TS 14961:2005 with the following additions:

Parameter	Value
Extreme values	cross section 10 cm² ; length 25 cm
Outlier	< 300 mm acceptable

The dimensioning of the biomass CHP plant is based upon the following fuel characteristics.

Table IV.A.3-6: Fuel characteristics as basis for CHP-dimensioning

Characteristic		Minimum	Dimensioning	Maximum
Water content	[%]	30	45	55
Ash content	[% of dry matter]	0.5	3.0	3.0
Nitrogen	[% of dry matter]	0,2	0,5	0,5
LHV	[kWh/kg]	1.8	2.3	3.5
Bulk weight	[kg/m³]	170	270	390

<u>Financial data</u>

The cost-benefit analysis for the comparison of the 3 CHP-Alternatives was mainly based upon the following prices and returns respectively:

Table IV.A.3-7: Basic values for cost-benefit analysis

Prices		
Fuel price for wood chips	35.00	USD/t (45% water content)
	23.33	EUR/t (45% water content)
	ca. 10.00	EUR/MWh
Fuel price for natural gas	12.00	USD/1 million BTU
	3.41	Million BTU/MWh
	40.01	USD/MWh
	26.67	EUR/MWh
Electricity price	0.08	USD/kWh
	80.00	USD/MWh
	53.33	EUR/MWh
Ash disposal price	20.00	USD/t
	13.33	EUR/t

Returns		
Power feed-in tariff (biomass CHP plants)	0.13	USD/kWh
	130.00	USD/MWh
	86.67	EUR/MWh

- The exchange rate was set at 1.5 USD/EUR.
- The annuity was set at 10.3 %, which amounts to an interest rate of 6.0 % over a period of 15 years.
- The internal rate of return shall yield 10 %.

IV.A.3.2 Conceptual Design

In order to provide heat for the district heating network with the aforementioned quantities and temperature range from wood, there are several different concept alternatives possible.

The heat generation in a heating station is technically the most simple and least expensive solution in terms of investment costs, but less economical than the operation of a combined heat and power (CHP) generation process. The maximum supply temperature of a low pressure hot water boiler is 105°C/221°F. And, high pressure hot water boilers are needed for higher supply temperatures.

The first alternative is a biomass CHP plant with a thermal oil boiler in combination with an ORC module. For economical reasons the supply temperature derived from the ORC facility is set to 80°C/176°F.

The second alternative is a biomass CHP plant with steam boiler system and a heating type steam turbine. The supply temperature derived from the heating turbine is set to 90°C/194°F.

The third alternative is a biomass CHP plant with steam boiler system and an extraction condensing type steam turbine. The maximum supply temperature provided by this plant is defined by the pressure level of the steam extraction. In the present case, the maximum supply temperature is set to 110°C/230°F.

In any case, hot water boilers fired with fossil fuels such as light fuel oil or natural gas are designed to provide for peak load and redundancy, while the biomass fueled boiler is mainly supplying the basic load.

IV.A.3.2.1 Alternative 1

Alternative 1 is a biomass CHP plant with the combination of a thermal oil boiler with ORC module and a low pressure hot water boiler.

The technical parameters for the alternative 1 are as follows:

Table IV.A.3-8: Technical parameters for Alternative 1

Biomass furnace and thermal oil boiler	Value	Unit
Combustion heat performance	4,815	kW
Fuel demand at LHP 2.3 kWh/kg	15,492	t/a
Thermal oil rated load	3,815	kW
Thermal oil supply temperature at rated load	310	°C
Thermal oil return temperature at rated load	250	°C
Max acceptable operation pressure, thermal oil facility	13	bar
Flue gas temperature at chimney	170	°C

ORC module	Value	Unit
Thermal oil supply temperature to ORC evaporator	310	°C
Thermal oil return temperature from ORC evaporator	250	°C
Capacity of ORC evaporator	3,485	kW
Thermal oil supply temperature to ORC preheater	250	°C
Thermal oil return temperature from ORC preheater	130	°C
Capacity of ORC preheater	330	kW
Total heat input of ORC	3,815	kW
Hot water supply/return temperature	80/60	°C
Hot water capacity	3,060	kW
Electrical output	727	kW

Biomass furnace and low pressure hot water boiler	Value	Unit
Combustion heat performance	3,786	kW
Fuel demand at 45% water content	5,398	t/a
Hot water rated load	3,000	kW
Hot water supply temperature at rated load	105	°C
Hot water return temperature at rated load	75	°C
Max acceptable operation pressure, hot water facility	16	bar
Flue gas temperature at chimney	170	°C

The flow sheet displaying the thermal oil process with ORC module (alternative 1, load point 1: dimensioning) appears in **Annex IV.A.3-B: Technical Data**.

Table IV.A.3-9: Heat and power generation for Alternative 1 for best case

Heat and power generation in final stage (best case)		
Maximum thermal output	6,060 20,70	kW Million BTU/h
Annual heat generation	32,191 109.84	MWh/a Billion BTU/a
Maximum electrical output	727 2.48	kW Million BTU/h
Annual power generation	5,816 19.85	MWh/a Billion BTU/a

Alternative 1 allows postponing the installation of the low pressure hot water boiler to a later date when the additional heat supply is needed and the operation of the wood fueled boiler is economical.

Table IV.A.3-10: Heat and power generation for Alternative 1 (worst case)

Heat and power generation in initial stage (worst case)		
Maximum thermal output	3,060 20.70	kW Million BTU/h
Annual heat generation	13,733 46,86	MWh/a Billion BTU/a
Maximum electrical output	727 2.48	kW Million BTU/h
Annual power generation	5,816 19.85	MWh/a Billion BTU/a

The sorted heat load graphs showing the heat generation and the power generation of the planned of the biomass CHP plant to the heat supply for Alternative 1 appear in **Annex IV.A.3-B: Technical Data**.

The layout drawing of the biomass CHP plant for Alternative 1 also appears in **Annex IV.A.3-B: Technical Data**.

IV.A.3.2.2 Alternative 2

Alternative 2 is a biomass CHP plant with a steam boiler and a heating turbine. The technical parameters for Alternative 2 are as follows:

Table IV.A.3-11: Technical parameters for Alternative 2

Biomass furnace and steam boiler	Value	Unit
Combustion heat performance	14,146	kW
Fuel demand at LHP 2.3 kWh/kg	45,517	t/a
Live steam rated load	13.99	t/h
Live steam temperature at rated load	465	°C
Live steam pressure at rated load	51	bar_{abs}
Max acceptable operation pressure, steam facility	60	bar
Flue gas temperature at chimney	170	°C

Heating turbine	Value	Unit
Live steam mass flow	13.59	t/h
Extraction steam mass flow	0.50	t/h
Exhaust steam mass flow	13.09	t/h
Electrical output	2,600	kW

Exhaust steam / hot water heat exchanger	Value	Unit
Exhaust steam temperature	93.5	°C
Exhaust steam pressure	0.8	bar_{abs}
Hot water rated load	8,000	kW
Hot water supply temperature at rated load	90	°C
Hot water return temperature at rated load	60	°C
Max acceptable operation pressure, hot water facility	16	bar

The flow sheet displaying the water steam process with heating turbine (Alternative 2, load point 1: dimensioning) appears in **Annex IV.A.3-B: Technical Data**.

Table IV.A.3-12: Heat and power generation for Alternative 2 for best case

Heat and power generation in final stage (best case)		
Maximum thermal output	8,000 27.32	kW Million BTU/h
Annual heat generation	33,103 112.95	MWh/a Billion BTU/a
Maximum electrical output	2,600 8.88	kW Million BTU/h
Annual power generation	20,800 70.97	MWh/a Billion BTU/a

Table IV.A.3-13: Heat and power generation for Alternative 2 for worst case

Heat and power generation in initial stage worst case		
Maximum thermal output	8,000 27.32	kW Million BTU/h
Annual heat generation	15,622 53.30	MWh/a Billion BTU/a
Maximum electrical output	2,600 8.88	kW Million BTU/h
Annual power generation	20,800 70.97	MWh/a Billion BTU/a

The sorted load graphs showing the heat generation and the power generation of the planned of the biomass CHP plant to the heat supply in Alternative 2 appear in **Annex IV.A.3-B: Technical Data**.

The layout drawing of the biomass CHP plant in Alternative 2 also appears in **Annex IV.A.3-B: Technical Data**.

IV.A.3.2.3 Alternative 3

Alternative 3 of a biomass CHP plant is made up of a steam boiler with an extraction condensing turbine. The technical parameters for Alternative 3 are as follows:

Table IV.A.3-14: Technical parameters for Alternative 3

Biomass furnace and steam boiler	Value	Unit
Combustion heat performance	22,231	kW
Fuel demand at LHP 2.3 kWh/kg	71,736	t/a
Live steam rated load	21.57	t/h
Live steam temperature at rated load	485	°C
Live steam pressure at rated load	66	bar_{abs}
Max acceptable operation pressure, steam facility	73	bar
Flue gas temperature at chimney	170	°C

In the extraction condensing turbine the steam which is not extracted for heat production is converted into energy in the low-pressure part of the turbo-generator. Thus three different load points – dimensioning (load point 1), average (load point 2) and maximum (load point 3) – are considered in the following:

Extraction condensing turbine	Value	Unit
Live steam mass flow	21.26	t/h
Extraction steam mass flow (load point 1)	17.00	t/h
Extraction steam mass flow (load point 2)	8.81	t/h
Extraction steam mass flow (load point 3)	2.40	t/h
Exhaust steam mass flow (load point 1)	4.26	t/h
Exhaust steam mass flow (load point 2)	12.46	t/h
Exhaust steam mass flow (load point 3)	18.86	t/h
Electrical output (load point 1)	4,125	kW_{el}
Electrical output (load point 2)	4,866	kW_{el}
Electrical output (load point 3)	5,445	kW_{el}

Extraction steam / hot water heat exchanger	Value	Unit
Extraction steam temperature	122	°C
Extraction steam pressure	2	bar_{abs}
Hot water rated load (load point 1)	10,000	kW
Hot water supply temperature at rated load	110	°C
Hot water return temperature at rated load	60	°C
Max acceptable operation pressure, hot water facility	16	bar

The flow sheets displaying the three load points of the water steam process of the biomass CHP plant in Alternative 3 appear in **Annex IV.A.3-B: Technical Data**.

Table IV.A.3-15: Heat and power generation for Alternative 3 for best case

Heat and power generation in final stage (best case)		
Maximum thermal output	10,000	kW
	34.15	Million BTU/h
Annual heat generation	35,083	MWh/a
	119.71	Billion BTU/a
Maximum electrical output	5,400	kW_{el}
	18.44	Million BTU/h
Annual power generation	38,930	MWh_{el}/a
	132.83	Billion BTU/a

Table IV.A.3-16: Heat and power generation for Alternative 3 for worst case

Heat and power generation in initial stage (worst case)		
Maximum thermal output	10,000	kW
	34.15	Million BTU/h
Annual heat generation	15,622	MWh/a
	53.30	Billion BTU/a
Maximum electrical output	5,400	kW_{el}
	18.44	Million BTU/h
Annual power generation	41,442	MWh_{el}/a
	141.34	Billion BTU/a

The sorted load graphs showing the heat generation and the power generation of the planned of the biomass CHP plant to the heat supply in Alternative 3 appear in **Annex IV.A.3-B: Technical Data**.

The layout drawing of the biomass CHP plant in Alternative 3 also appears in **Annex IV.A.3-B: Technical Data**.

IV.A.3.3 Technical description

IV.A.3.3.1 Fuel storage and transport

The natural wood chips needed for fuel are delivered by trucks only. For truck trailers with a walking floor, hydraulic tipping devices or other unloading devices are not commonly used in the US; a truck dumper is typically used for unloading wood chips.

The entire truck is tipped lengthwise by the truck dumper. The wood chips run out of the trailer into a pit where they are automatically removed and transported to the open-air storage facility.
The truck dumper is included in the investment costs of the biomass CHP plant.
The fuel storage concept is based on fuel transport and fuel blending by means of a wheel loader and automatic push floor units.

The open-air wood chip heap serves as an interim storage facility for the biomass CHP plant. From there the fuel is transported to the automatic storage facility by means of a wheel loader.

Figure IV.A.3-1: Push floor unit before operation

The disadvantages of push floor units are as follows:

- Staff required for fuel handling
- Considerable amount of space required due to low-ceiling storage depot (approximately 4 meters)

Figure IV.A.3-2: Automatic fuel storage facility with two push floor units

The following advantages outweigh the disadvantages:

- Quality assurance measures are possible due to acceptance checks
- Impurity separation, especially of ferrous metals, can be accomplished
- Dust collection in the transport area can be established
- Fuel particle size can be guaranteed by means of an overlength separator

It is advisable to deposit different fuel qualities onto different push floors, in particular when using wet wood. Thus, the homogenizing of the fuel is ensured.

So far, two push floor units are planned for each alternative. It would be wise to consider whether the bigger plant size in Alternative 3 and possibly even Alternative 2 requires the installation of a third push floor. We have allowed for the potential required space in our planning.

Subsequently, the fuel is transported to the fuel buffer of the biomass furnace by means of an oscillating conveyor and a drag chain conveyor.

IV.A.3.3.2 Impurity processing (option)

Impurity processing can optionally be carried out as part of the fuel transport.

The processing consists of the following individual components:

- Separator for ferrous metals (overbelt magnetic separator) (optional)
- Overlength separator (pulley / disc filter) (optional)

- Separator for ferrous materials (drum magnet to protect separator for non-ferrous materials)
- Separator for non-ferrous materials (optional)

For the planned fuel are natural wood chips, it may be necessary to leave out the separators for ferrous and non-ferrous materials and simply install the overlength separator.

IV.A.3.3.3 Firing system

Push grate furnace

The push grate furnace is the most efficient and economic way of using coarse wood pieces and is used in most plants with a capacity of up to approx. 60 MW of firing.

The advantage of the system lies in the fact that pieces of up to 400 mm length can be incinerated. Only longer pieces have to be sorted out.

Figure IV.A.3-3: Push grate furnace before installation

Figure IV.A.3-4: Push grate furnace in operation

The market offers air- and water-cooled push grates. The water-cooled grate is without a doubt the more advanced solution. Its advantage over the air-cooled grate lies in the fact that the control cycles of grate cooling and fire guiding are completely separate. The added primary air of the air-cooled grate, on the other hand, does not only have to cool down the grate bars but also needs to optimize and control the wood combustion process.

Last but not least, it is a question of cost. Water-cooled grates with their rather complex design and focus on waste combustion are for economic reasons, normally ruled out for wood combustion. For this reason the partly water-cooled grate has been developed. Here, only the stationary elements of the grate are water-cooled. In comparison to the ordinary water-cooled grate, this type of grate is easier and more cost-efficient.

However, an air-cooled grate should be sufficient for this project, considering system size and the natural wet fuel. Any further planning is therefore based on the air-cooled alternative. There is nevertheless the possibility of testing the alternative of a partly air-cooled grate in further steps.

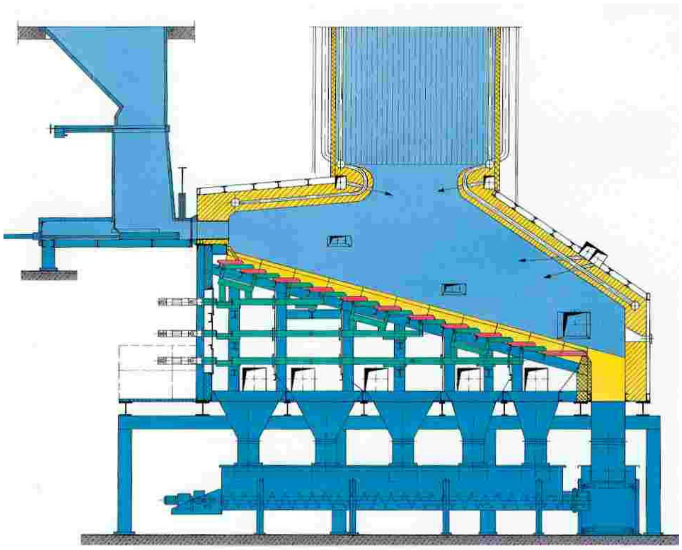

Figure IV.A.3-5: Sectional view of a combustion chamber with push grate furnace

<u>**Combustion air**</u>

The combustion air is fed in different stages of the combustion chamber. This is of particular importance in order to minimize NOx formation and to reduce flue gas losses (O_2 minimization).

- Primary air (undergrate air) is inlet from the upper area of the boiler house and fed into the individual air zones. Every zone is fitted with a control butterfly valve which ensures an optimum setting for combusting the wood remains.
- The secondary air is injected into the combustion chamber above the actual grate system. The valves are controlled against the O_2 provision.
- The tertiary air can be injected above the grate as the last combustion air stage. This combustion in stages ensures an optimum burnout of the flue gases and allows the system to operate with optimum O_2 concentration.

There is the possibility, in connection with secondary air, to feed flue gases directly back into the combustion chamber as well as below the grate by means of a flue gas re-circulation. This is first and foremost meant to reduce the temperature in the combustion chamber, but also positively affects the reduction of NOx formation.

For it is planned to use larger quantities of wet, natural wood due to the lower heating value, the combustion air needs to be pre-heated.

Here, we recommend using a steam-driven air pre-heater. Unlike a flue gas air pre-heater the steam air pre-heater can be left aside in case there is only dry wood to be used at a certain time. This ensures a maximum variability with regard to the fuel quality used.

IV.A.3.3.4 Boiler systems

Thermal oil boiler

Thermal oil boiler systems reclaim the energy in the hot exhaust gases and transfer it to an organic fluid. The thermal fluid allows high temperatures with low pressures in the system and heat consumers.

The main component of the heat recovery system is the exhaust gas heater. The thermal energy in the hot exhaust gases from the firing plant is transferred to the heat transfer fluid.

To burn clean natural fuels, the compact exhaust gas heater is a very good solution. Convection and radiant heater are integrated in one common sheet. This allows a compact and cost-efficient design.

In 2-pass heaters the exhaust gases are reversed only once. In the convection section the exhaust gas flows parallel.

Steam boiler

Steam is generated in a water-tube boiler which is mounted on top of the furnace and therefore requires a tall boiler house.

This multiple-flue boiler system is available as a waste heat boiler with the relevant secondary equipment, such as evaporator, superheater, and economizer, or as a water-tube boiler using angle tube fitting with an overhead steam drum for generating saturated steam.

The boiler is supplied with completely demineralized water in accordance with the technical regulations by means of a feed water device.

The boiler is subject to regular checks and is to be controlled in recurring intervals by an appointed body.

SNCR nitrogen oxide reduction facility (option)

Considerable amounts of NOx loads are emitted, despite an optimized wood combustion taking place on the push grate. If necessary, one way to reduce these emissions by means of an SNCR unit is, nevertheless, described in the following.

The reduction of nitrogen oxide would be carried out as non-catalytic nitrogen oxide reduction (SNCR). A reducing agent is injected into the combustion chamber. Nitrogen and water vapor result from the reduction of the nitrogen oxides.

The reducing agent is stored in the storage tank. The agent is supplied to the customer with tank trucks. The storage tank is filled by means of a hose connection.

IV.A.3.3.5 Dust removal from flue gas

At first, the flue gas is pre-dedusted in a cyclone filter in order to pre-filter particulate impurities and to filter smoldering ash particles.

Subsequently, the dust in the flue gas is reduced by means of an electrostatic precipitator. Depending on the design, particle concentrations in clean gas between 10 and 50 mg/m³ can be achieved with electrostatic precipitators. The planned technology can achieve 20 mg/m³.

Cyclone filter

The cyclone filter is used to pre-de-dust flue gases leaking from the boiler, which contain dust and possibly glowing ash particles. It consists of a cylindrical body with a conic base, tangential crude gas entry pipe, immersion pipe with flue gas entry pipe and the required dust discharging devices.

The dust-loaded flue gas enters the cyclone filter body via the crude gas entry pipe. Due to the tangential design of the pipe the flue gas starts to rotate and thus follows a spiral, downward flow inside the body.

The rotating flue gases are diverted upwards when they reach the lower end of the body and then leave the cyclone body via the immersion pipe fitted inside the body shaft. The dust gathered in the dust collection hopper is discharged using dust discharging devices. As much as possible, flow breakers ensure that the dust is not stirred up again.

Electrostatic precipitator

Solid particles are charged positively under high voltage by means of spray electrodes in the crude gas flow. Due to the resulting electrostatic forces, the positively charged particles are attracted by negatively poled collecting electrodes and deposited there. The deposited particles are then knocked off by regular mechanic impulses and transported outside for disposal via a screw.

The risk of fire or explosions due to larger accumulations of partially burned material in the electrostatic precipitator is a disadvantage. This problem can be minimized by installing a cyclone filter upstream and thus ensuring that glowing wood particles are filtered in time. The operating temperature of electrostatic precipitators is another important aspect to be considered. They can be operated at temperatures of up to 300°C. So as to avoid the De Novo synthesis of dioxins, temperatures should be kept below 200°C.

For this reason, a flue gas temperature of 160-180°C is designed at the boiler outlet; it is also meant to minimize flue gas losses.

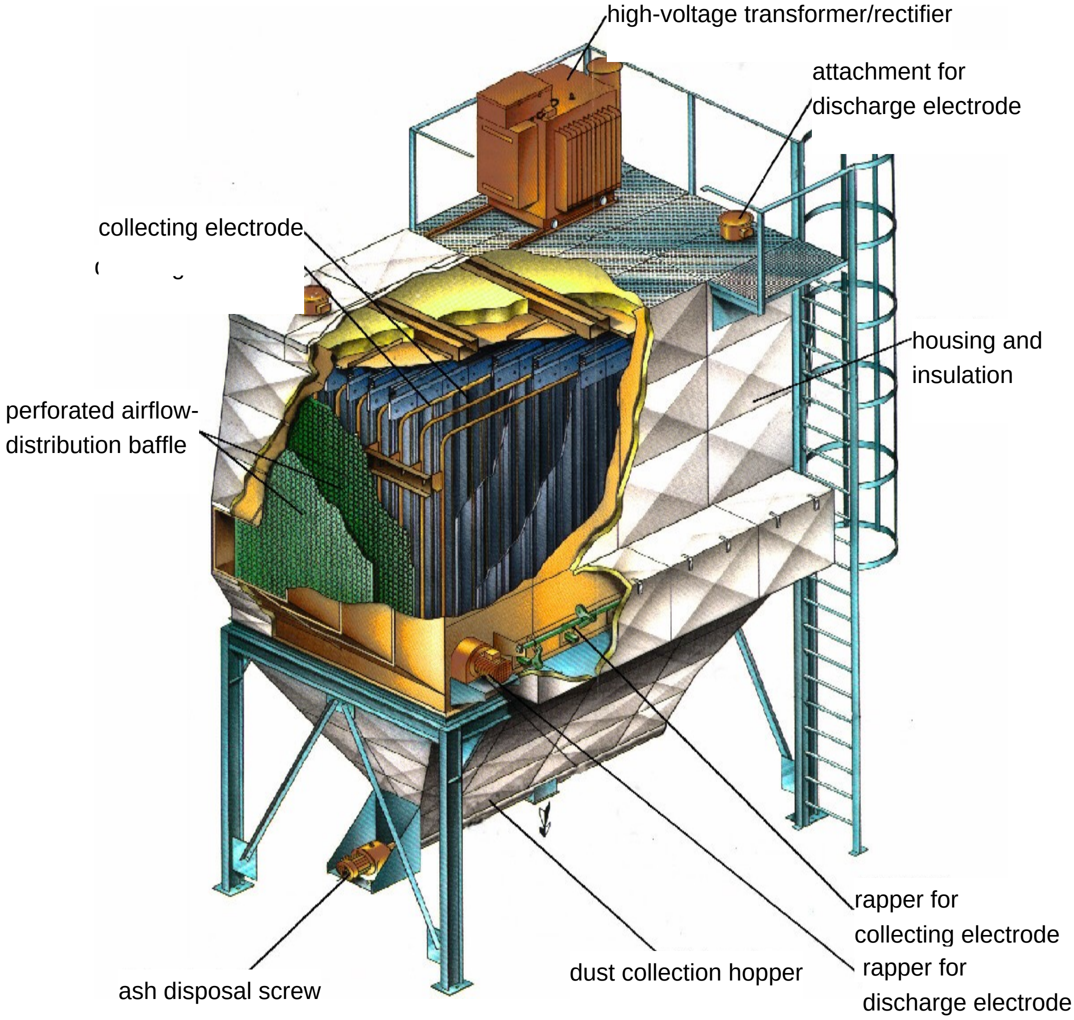

Figure IV.A.3-6: Sectional view of an electrostatic precipitator

Ash disposal

The residues are fed mechanically from the dust collection hopper into an ash container. When it is filled, the ash container is regularly replaced by an empty container and the full one is removed with trucks.

All devices conveying dust, starting with the discharge at plant components that have come into contact with flue gas up to entering the residue silo are insulated and heated so as to avoid operating problems due to sticking.

Depending on the components, the entire ash production will come to about 5% of the dry matter wood input.

Wet ash is one of the residues consisting of bottom ash and water added in the wet ash conveyor (approximately 30% in weight) as well as boiler slag (superheater and economizer). The wet ash is deposited into the ash box and manipulated by means of a wheel loader.

Ash silo (option)

Optionally, a pneumatically fed ash silo can be installed as intermediate storage of residues from the flue gas dust removal.

The residue silo is designed as a cylindrical bulk material silo with conical hopper and rotary star valve at the run-out. The silo is completely insulated and is heated at the cone to ensure an uninterrupted discharge of solids. When the silo is full, the residue is loaded into silo trucks by a loading unit.

The filter ash is automatically transported into a residue silo and removed with trucks.

Flue gas cleaning (option)

At present it is assumed that a complex flue gas cleaning process using absorbent materials such as lignite coke and calcium hydroxide or sodium carbonate with a bag filter does not need to be carried out.

This needs to be checked with the authority.

Emission measurement

The required measuring equipment is set up in a measuring container close to the measuring point. The container will be air-conditioned and heat insulated if required. As far as this is possible, all measuring equipment should come as and be used as self-calibrating equipment working without test gas.

Flue gas discharge

The flue gas from the wood furnace is emitted in the atmosphere from a free-standing self-supporting chimney.

IV.A.3.3.6 Heat and power cogeneration

ORC facility

One of the technologies that has proven its suitability in practical operation for years is ORC technology. About 120 ORC power plants with capacities ranging between 200 kW and 2,200 kW (per module) have been operating in central Europe since 1998, most of which are used in biomass power plants.

The heat supply for the ORC combined heat and power plant takes place indirectly through thermal oil circulation, which receives its energy from energy-rich flue gases, which are generated in biomass combustion. The ORC-module tied-up in the thermal oil circuit functions principally as a conventional steam plant. Silicone oil is used instead of water as working medium in a closed circuit, which is pressurized in a heat exchanger (evaporator) with thermal oil, vaporized and expanded in a steam turbine with generator. The fluid is recooled in a condenser up to the liquid state after it has passed on a large part of its energy to the regenerator and once again supplied to the evaporator through a feeding pump. The heat released during condensation is conveyed to a hot-water circuit and used for heating buildings or other technical processes.

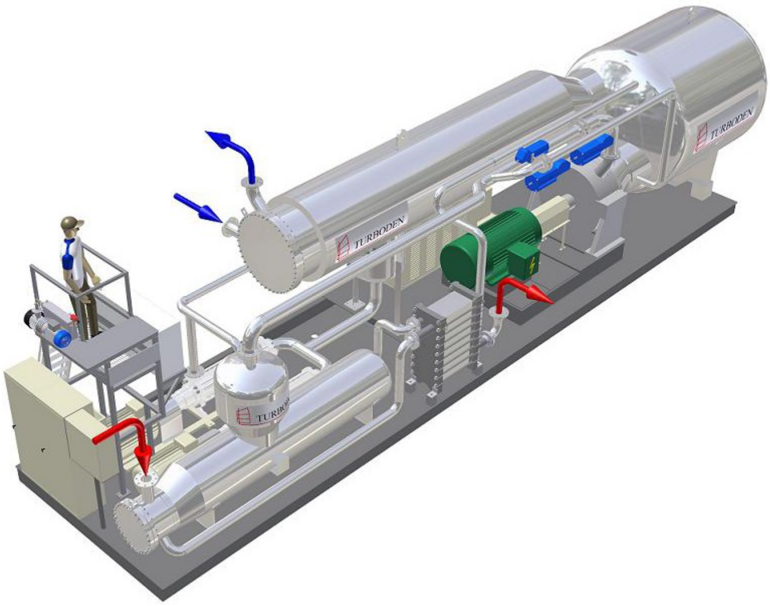

Figure IV.A.3-7: View of an ORC module

The medium voltage switchgear distributes the electrical energy from the generator of the ORC turbine to the auxiliary power transformers of the biomass CHP plant and exports it into the medium voltage transformer.

The emergency power system is meant to ensure a safe shutdown of the biomass CHP plant in case of a blackout.

The low voltage switchgear supplies the electric consumers of the biomass CHP plant with electric energy.

Water steam process with steam turbo-generator

The piping system is set up to ensure the boiler is operating faultlessly even if the turbine fails. Pneumatically controlled turbine bypass valves are used to ensure a safe supply of pressure stages both above and below atmospheric pressure. Thus, the operation of the bypass valves is possible in all load levels and pressure stages (dry start-up of the superheaters). Furthermore, in case the turbo-generator trips, the biomass CHP plant can continue to operate smoothly.

There are different designs of steam turbo-generator available on the market. The present capacity suggests using a reaction type multi-stage steam turbine.

Heating type steam turbine

In a heating turbine process (Alternative 2) the power generation is directly linked to the heat generation (*i.e.* a reduced heat production results in a reduced power production and vice versa). Therefore, the biomass CHP plant is equipped with a cooler for the release the waste heat to the ambient atmosphere in order to enable a maximum power generation at any time.

The hot water needed for the district heating system is generated by the condensing of the exhaust steam from the turbine and the heat exchange in a heat condenser.

The heat condenser is fitted in the turbine room preferably located underneath the turbine.

Extraction condensing type steam turbine

In a process applying an extraction condensing turbine (Alternative 3) the power generation is reversely linked to the heat generation (*i.e.* a reduced heat production results in a increased power production and vice versa). This is because the less steam extracted from the turbine for the heat generation, the more steam expanded in the low-pressure part of the turbine, thus, more power is generated.

The turbine exhaust steam is led from the turbine house and condensed in an air-cooled condenser for the release the waste heat to the ambient atmosphere in order to enable a maximum power generation at any time. Therefore the biomass CHP plant is equipped with an air-cooled condenser which is set up for the maximum steam capacity.

The condensate is delivered from the hotwell of the air-cooled condenser to the condensate container by means of pumps.

The hot water needed for the district heating system is generated by the condensing of the extraction steam from the turbine in a heat exchanger.

Condensate drain from the heat exchanger takes place in free incline to the condensate container. From there, the condensate is pumped into the degasser.

IV.A.3.4 Feedwater supply

The feedwater supply of the boiler is set up as a physical water treatment whose main component is a reverse osmosis (RO) unit.

The completely demineralized feedwater is supplied to enable alkaline operation mode.

IV.A.3.5 Peak load and redundancy boiler

Fossil fired peak load and redundancy hot water boilers are envisaged in order to provide for both an economic peak load supply and a year-round operation of the biomass CHP plant.

IV.A.3.6 Electrical equipment of the plant

The electrical equipment of the biomass combined heat and power plant essentially consists of the following elements:

- Connection to medium-voltage power grid
- Medium voltage transformer
- Medium voltage switchgear
- Auxiliary power transformer
- Low voltage switchgear
- 110 VDC battery system and uninterrupted power supply (UPS)
- Grounding system, potential equalization, insulation, measures to ensure electromagnetic compatibility (EMC)
- Lightning protection system
- Low voltage distribution board HVAC
- Electrical installation HVAC
- Lighting, safety lighting
- Data processing and telecommunications system
- Fire detection system
- CCTV

IV.A.3.7 Emergency power system

The emergency power system is meant to ensure a safe shutdown of the biomass CHP plant in case of a blackout. It is needed for safe shutdown of the thermal oil boiler.

For the following reasons it is unlikely that an emergency power system is needed for the steam boiler:

- The boiler needs to be run through an evaporation test
- Due to low pressure losses in the flue gas system, the extraction of the flue gas from the combustion chamber can be ensured by natural draft.

IV.A.3.8 Auxiliary systems of the plant

The following auxiliary systems are envisaged for the biomass CHP plant:

- Compressor unit
- Heating, ventilation, and air conditioning

IV.A.3.9 Profitability assessment and recommendation

For each of the three alternatives a cost-benefit analysis was executed in approximate and static terms to enable an economical comparison and a recommendation for the most promising alternative based on this first assessment.

The cost-benefit analysis of each of the three alternatives is based on the general conditions aforementioned in **Chapter IV.A.3.1**.

The profitability assessments for the alternative concepts appear in **Annex IV.A.3-C: Financial Data**.

The goal of cost-benefit analysis is to provide for an economical comparison of the alternative concepts by just one single characteristic figure which is the minimum specific heat generation costs.

The following table displays the outcomes for the minimum required specific heat generation costs of each of three alternatives for the best case (design case).

Table IV.A.3-17: Specific heat generation costs for Alternatives 1- 3

Minimum specific heat generation costs (best case)		
Alternative 1	41.15	EUR/MWh
	18.09	USD/Million BTU
Alternative 2	44.15	EUR/MWh
	19.41	USD/Million BTU
Alternative 3	40.10	EUR/MWh
	17.63	USD/Million BTU

Obviously, the high-pressure steam boiler in combination with the extraction condensing turbine (alternative 3) gives the least specific heat generation costs. The combination of the thermal oil boiler with the ORC module (Alternative 1) results in slightly higher specific heat generation costs while those of the combination of the high-pressure steam boiler with the heating turbine (Alternative 2) are significantly higher.

Thus, the comparison estimates Alternative 3 as the most promising concept for the project. But from an economical point of view Alternative 3 and Alternative 1 are fairly equivalent.

From a technical point of view, all three alternatives represent reliable technologies that have already proven their suitability in practical operation for years (ORC facility) or even decades (steam turbines).

However, Alternative 3 is the only concept that allows for increased power generation when the heat demand is lower than estimated, *e.g.* in the initial stage of the project (worst case). This gives Alternative 3 a clear advantage over the others.

IV.A.4 Potential Project Sites

IV.A.4.1 Utility Demands and Annual Requirements

The proposed biomass combined heat and power (CHP) plant is intended to operate with one 10 MW output biomass combined heat and power system with a peaking 5 MW output natural gas combined heat and power system. These systems have requirements for potable, softened water, power, natural gas or diesel fuel oil, wastewater discharge, and steam distribution.

The utility demands are comprised of facility and process demands. Process demand values have been obtained from Seeger via Lahmeyer International GmbH, and have been converted from metric to imperial units for use in evaluating demands. Facility demands are estimated as a percentage of process demands based on the size of the plant. The facility demands are a rough estimate only; however, the process demands are generally more significant in terms of estimation of sizing for required utility connections. Steam distribution sizing has not been evaluated at the time of this report. No existing steam distribution currently exists for the heat component of the CHP systems.

Annually, the facility consumes 5.3 million gallons of water, 4800 MW of electricity, 12 million cubic feet of natural gas, and discharges 2 million gallons of wastewater.

Table IV.A.4-1: ESTIMATED UTILITY PEAK DEMANDS

	Estimated Process		Estimated Facility		Estimated Total	
Instantaneous Peak Value	**Peak Demand**		**Peak Demand**		**Peak Demand**	
Water Consumption	26.4	gal/min	15	gal/min	50	gal/min
Power Demand	1,500	kW	200	kW	1,700	kW
Natural Gas Consumption	56,844	SCFh	1,000	SCFh	58,000	SCFh
Wastewater	16.3	gal/min	15	gal/min	35	gal/min

See annexes for full conversion from provided metric data, clarifications, and assumptions. Note: no facility demands are included in the above table. Metric process data provided by Lahmeyer International GmbH.

Table IV.A.4-2: ESTIMATED ANNUAL UTILITY DEMANDS

Annual Process Demand		
Water Consumption	5,280,000	gal/year
Power Demand	4,800	MW/year
Natural Gas Consumption	11,940,000	SCF/year
Wastewater	2,020,000	gal/year

Values per year. See appendices for full conversion from provided metric data, clarifications, and assumptions. Note: no facility demands are included in the above table.

IV.A.4.1.1 Natural Gas Connection

The utility Natural Fuel Gas Company provides Smethport, PA with natural gas. While natural gas pressure data is considered intellectual property by the utility, most suppliers are able to provide at least 2 psi at the street and potentially more depending on the anticipated demand and use. Should natural gas not be available with sufficient pressure or quantity on site, a booster pump system can be designed.

IV.A.4.1.2 Water Main Connection

The water mains sizes proximate to the sites vary between 8" and 15" diameter, and are generally adequate in size for the required flow of 50 gal/m. A hydrant testing will be required to determine if the 58 psi (133 ft of water) demand can be met by the existing water main. A water booster pump can be designed to be able to meet the requisite demands of the process.

IV.A.4.1.3 Electrical Power

Electrical power connections for the CHP plant consist of an operational service (parasitic load) of the facility, and generated electrical power output. Each of the two power considerations are discussed as follows:

- CHP Plant Power

The CHP plant demand load of 1700kW can be supported by a pad mounted 2500kVA 12.47kV/480V transformer which would be serviced by existing Smethport Borough (Borough) aerial 12.47kV lines. A black start standby natural gas generator should be considered to enable the CHP facility to restart and operate in the event of a total First Energy grid outage.

- CHP Generation

The CHP plant will be capable of generating of approximately 4.2MW of available electrical power. This power can be utilized to support the present day Smethport Borough loads in addition to providing up to approximately 2.5MW of energy available for export to the utility grid. The historical Borough electrical demand is 2.9MW peaking in the early summer period. The average Borough load is estimated to be 2.2MW. The Borough is currently serviced by a 12.47kV loop service with the point of connection (POC) near the proposed CHP site 2. The interconnection of the CHP plant with capacity to export power to the utility grid is governed by the transmission operator (TO) Penelec and the regional transmission organization (RTO) PJM. A one line diagram of the proposed CHP to grid interconnection is depicted in Figure 4. This figure depicts the required step up or isolation transformer as well as switchgear and breakers to accomplish the interconnection. The interconnection process will require extensive and somewhat lengthy application and review process with both First Energy and PJM. The loop configuration connection of the First Energy 12.47kV lines provides a flexible utility source for the Borough, but may also complicate the interconnection process. In the event of a trip of either utility source capable of feeding the Borough, First Energy and or PJM may require upgrades and transfer trip mechanisms to protect and isolate the utility network from the CHP power. Additional utility line or point of interconnection (POI) upgrades may be required as a result of the review and approval process with the TO and PJM.

IV.A.4.1.4 Wastewater

The wastewater mains sizes proximate to the sites vary between 8” and 15” diameter, and are generally adequate in size for the required wastewater discharge. However, verification of temperature, quantity, and quality of wastewater discharge have not been confirmed or coordinated with the local utility.

IV.A.4.2 Overall Utility Requirements and Site by Site Evaluation

IV.A.4.2.1 Site 1

Site 1 is proximate to Route 6 and has reasonable access to natural gas utility lines, an 8” diameter water main, and an 8” diameter wastewater main. Aerial 12.47kV Borough Power is available along Route 6 as well.

- 8” diameter water main is generally adequate for the anticipated demand
- 8” diameter wastewater main is generally adequate for the anticipated demand
- Natural gas is proximate and generally available, although the pressure and flow availability are being confirmed

Electrical power is available that will likely support the CHP plant load. A new service consisting of a pad mounted 12.47kV/ 480V transformer could be installed to support the plant if necessary. Utilizing the existing Borough electrical supply lines as a conveyance to export power from the CHP is questionable. This location is at the farthest point from the utility supply in the Borough electrical network. A detailed load flow study would need to be conducted to determine if the existing Borough network of various conductor sizes and protective devices would be capable of properly supporting the new directional power characteristics of the CHP plant during all anticipated load conditions. The results of the load flow study may indicate that various sections of the Borough power system may need to be upgraded to accommodate this location.

IV.A.4.2.2 Site 2

Site 2 is proximate to East Street and has a long line installation for natural gas. Local power is available from a Penn Electric 12.5 kV line, and also has an available 8" water main onsite, as well as a 15" sanitary on site.

- The natural gas line required will be long, according to the natural gas utility. Pressure and flow will need to be confirmed and possibly boosted by additional equipment.
- An 8-inch water main onsite is generally adequate for the anticipated demand
- A 15-inch sanitary main onsite is generally adequate for the anticipated demand
- The Penn Electric substation is local to this site

IV.A.4.2.3 Site 3

Site 3 is proximate to Site 2 on East Street and will have a similar long line installation for natural gas. The local substation is further away from the Penn Electric 12.5 kW line and there is no onsite available sanitary. The 8-inch water main is onsite.

- The natural gas line required will be long, according to the natural gas utility. Pressure and flow will need to be confirmed and possibly boosted by additional equipment.
- An 8-inch water main onsite is generally adequate for the anticipated demand
- No available onsite sanitary main

The Penn Electric substation is further away than at Site 2

IV.A.5 Site Plan and Facility General Arrangement

Based upon the initial feedback from the Borough and Borough advisory team, Site 3 will be the site that is evaluated for general arrangement and site plan development. Site 3 – parcel number 24-0280107 is directly to the East of Site 2 with the closest intersection of East Street and Railroad Avenue. The site has a significant amount of Acreage that is consumed by the National Wetland Inventory; however has sufficient acreage for the proposed facility.

The General Arrangement for the facility can be found in the attached Figure 3.1 General Arrangement (GA). The General Arrangement for the facility was provided by Seeger based upon the concept level process design. The GA consists of the following attributes:

- Road access for wood deliveries, personnel and operations staff, and deliveries
- Truck unloading facilities
- Wood storage facilities
- Push floor conveyors
- Power house
- Outbuildings
- Boiler house
- Ash removal and particulate removal area
- Heat distribution
- Boiler room

Final design details will be considered to add areas for fire water storage and office/break areas.

IV.A.6 Environmental Impacts, Evaluations, and Permits

IV.A.6.1 Right-To-Build Permitting & Approvals

A tabular summary of potential local, State and federal regulatory programs applicable to the construction of the proposed project is included in Appendix IV.A.6-A. The tabular summary identifies the type of permit, regulated activity, jurisdictional agency, estimated regulatory review timeframes, and an indication of the programs relevancy to the specific site (*i.e.*, Site 1, 2, or 3).

Relevant permitting programs can be grouped into two general categories: 1) activity-specific, and 2) site-specific.

Activity-specific permitting programs. Activity-specific permitting programs are relevant to the type of activities associated with the project. For example, the project, regardless of the location, will result in the generation of air emissions, which will require the acquisition of an air permit from the Pennsylvania Department of Environmental Protection (PADEP). Other examples of activity-specific permitting programs include: storage tank registrations, NPDES permits, residual waste permits, and local right-to-build (zoning) related approvals. Activity-specific permit programs are tagged as such in the permit summary table provided in Appendix IV.A.6-A (A = activity-specific).

Site-specific permitting programs. Site-specific permitting programs are relevant to the individual baseline site characteristics (see Section IV.A.6.2) and, consequently, have a greater impact on the site selection process than activity-specific permitting programs. For example, the location of the limits of construction on a particular site within a 100-year flood boundary or within regulated wetlands will require review by jurisdictional regulatory agencies in a discretionary review process; whereas a site absent of such characteristics would forgo such reviews. The additional reviews can increase the overall schedule and cost; with no assurance that such discretionary approvals will be obtained. Consequently, these types of permits have a greater impact on making an informed decision in the site selection process. Site-specific permitting programs are also tagged in the permit summary table included as Appendix IV.A.6-A (S = site-specific).

IV.A.6.2 Baseline Environmental Characteristics

Baseline environmental data covering the project sites was compiled from existing, readily available sources including internet-based Geographic Information System (GIS) resources. Data for the following resources were obtained:

- 100-year Flood Zones
- National Wetland Inventory4
- Natural Heritage Inventory Sites (see Appendix IV.A.6-B)
- Soils (see Appendix IV.A.6-C)

The data and sources are illustrated on Figures 1.1 through 1.4, and summarized by site below. Desk-top resource reviews were supported by on-site reconnaissance. Site photographs are included in Appendix IV.A.6-D.

Site 1. Figures 1.1, 1.2 and 1.4 consist of an aerial photograph of Site 1 overlaid by environmental resource data obtained through readily available published sources. The data indicates that the limits of construction on Site 1 **do not include** a 100-year floodplain boundary or other protected water bodies (including wetlands), or known archaeological or cultural resources (*i.e.*, sites listed on the National Register of Historic Places).

A review of web-published soil data (http://websoilsurvey.nrcs.usda.gov/app/) (see also Figure 1.1) indicates that the site is predominantly overlain by Albrights silt loam (AbB), with the following predominant soil characteristics:

- 3 to 8 percent slopes
- Moderately well drained
- Depth to restrictive layer: 18 to 32 inches to fragipan5

[4] National Wetland Inventory (NWI) maps are published by the United States Fish & Wildlife Service (USFWS). NWI maps are based on interpretation of high altitude aerial photograph and are used as an indication of potential federal wetlands. The presence or absence of federal wetlands should be field-verified through the performance of a wetland delineation conducted by a wetland biologist in accordance with the United States Army Corps of Engineers' "Wetland Delineation Manual" (1987).
[5] A dense, natural subsurface layer of hard soil with relatively slow permeability to water, mostly because of its extreme density or compactness rather than its high clay content or cementation.

- Depth to water table: 12 to 30 inches
- Frequency of flooding: none

Site-specific soil borings would be necessary to identify design/constructability-related issues including building code compliance.

Site 2. Figures 1.1, 1.3 and 1.4 consist of an aerial photograph of Site 2 overlaid by environmental resource data obtained through readily available published sources. The data indicates that the limits of construction on Site 2 **include** a 100-year floodplain boundary[6], as well as potential federal wetlands[7]; no known archaeological or cultural resources were identified. The acquisition of permits would be necessary if work is proposed within these areas (see Appendix IV.A.6-A).

A review of web-published soil data (http://websoilsurvey.nrcs.usda.gov/app/) (see Figure 1.1) indicates that the site is predominantly overlain by Atkins silt loam (At) and Pope Loam (Po), with the following predominant soil characteristics:

<u>Atkins Silt Loam (At)</u>

- 0 to 3 percent slopes
- Poorly drained
- Depth to restrictive layer: 60 to 99 inches to lithic bedrock
- Depth to water table: 0 to 12 inches
- Frequency of flooding: frequent

<u>Pope loam (Po)</u>

- 0 to 3 percent slopes
- Well drained
- Depth to restrictive layer: >80 inches

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[6] Work within the 100-year floodplain would require authorization from the local floodplain administrator. Floodplain development would be required to meet the "no adverse affect" criteria (*i.e.*, no physical damage to an adjoining or other property). To comply, proposed new facilities within the floodplain would need to be constructed on foundations with finished floor elevations at least two-feet above the base flood elevation or otherwise flood-proofed. Additional analysis/modeling might be necessary, as well as potential mitigation to provide for compensatory storage to eliminate a potential rise in the 100-year flood elevation due to flood displacement by new buildings/structures.

[7] Construction within a federal wetland requires authorization from the United States Army Corps of Engineers (USACE). Depending upon the extent of encroachment, the application could consist of a project-specific permit or authorization under the USACE's Nationwide Permit (NWP) program. An application or notification (in the case of a NWP) to the USACE would include a federal wetland delineation, as well as documentation that the proposed encroachment is the "Least Environmentally Damaging Practicable Alternative." Permanent encroachments (*i.e.*, loss of wetlands) may require submission and approval of a compensatory mitigation plan that includes the creation of wetlands or an acceptable alternative to replace the functions and values of the lost resources.

- Depth to water table: >80 inches
- Frequency of flooding: occasional

Site-specific soil borings would be necessary to identify design/constructability-related issues including building code compliance.

Site 3. Figure 1.1, 1.3 and 1.4 consist of an aerial photograph of Site 3 overlaid by environmental resource data obtained through readily available published sources. The data indicates that the limits of construction on Site 3 **do not include** a 100-year floodplain boundary or other protected water bodies (including wetlands)[8], or known archaeological or cultural resources (*i.e.*, sites listed on the National Register of Historic Places).

A review of web-published soil data (http://websoilsurvey.nrcs.usda.gov/app/) (see Figure 1.1) indicates that the site is predominantly overlain by Albrights silt loam (AbB), with the following predominant soil characteristics:

- 3 to 8 percent slopes
- Moderately well drained
- Depth to restrictive layer: 18 to 32 inches to fragipan
- Depth to water table: 12 to 30 inches
- Frequency of flooding: none

Site-specific soil borings would be necessary to identify design/constructability-related issues including building code compliance.

IV.A.6.3 Regulatory Agency Consultation

Pennsylvania Natural Diversity Inventory. It is the policy of the PADEP to ensure that permit applications received by the Department and County Conservation District staff (under delegated duties from PADEP) are coordinated through the Pennsylvania Department of Conservation and Natural Resources' (DCNR) Pennsylvania Natural Diversity Inventory (PNDI). The PNDI is the main source of information utilized by PADEP during the permit application review process for the protection of special concern species and resources. The PNDI coordination effort facilitates the avoidance and minimization of impacts to endangered and threatened and special concern species and resources (*i.e.*, plant and animal species classified as rare, tentatively undetermined or candidate as well as other taxa of conservation concern, significant natural communities, special concern populations [plants] and unique geologic features) in the Commonwealth of Pennsylvania. Coordination is conducted during the permit review and evaluation process.

[8] Potential federal wetlands, as indicated on the National Wetland Inventory mapping, exist on Site No. 3 outside of the proposed limits of construction. Site reconnaissance should be conducted to verify the presence or absence of regulated wetlands.

The PNDI Internet Database (http://www.gis.dcnr.state.pa.us/hgis-er/Login.aspx) provides a preliminary method of screening projects for potential impacts on resources of special concern. A preliminary review of the PNDI Internet Database was conducted on a geographical area encompassing the three alternative sites. A summary of the review is provided below, with the complete results (PNDI Project Environmental Review Receipt) provided as Appendix IV.A.6-E. **The results are identical among the three sites and, consequently, are not a differentiator between them.**

- PA Game Commission – No known impact[9]; no further review required.
- DCNR – No known impact[5]; no further review required.
- PA Fish and Boat Commission (PFBC) – **Potential impact; further review required.** (Note: The preliminary screening identifies two PFBC special concern species: Elktoe (*Alasmidonta marginata*) and Creek Heelsplitter (*Lasmigona compressa*) (see Appendix IV.A.6-F). Both species are freshwater mussels found in medium to large size streams, but are most common in smaller streams (http://www.naturalheritage.state.pa.us/Factsheets.aspx). Based on the type of activities proposed (*i.e.*, no work in streams), as well as mitigation necessary to minimize potential erosion and sedimentation impacts on adjacent streams, significant adverse impacts on these species are not anticipated).
- USFWS – No known impact[10]; no further review required.

This review is based on the project information that was entered. The jurisdictional agencies and PADEP require that the review be redone if the project area, location, or the type of project changes. If additional information on species of special concern becomes available, this review may be reconsidered by the jurisdictional agency.

PA Historical & Museum Commission (PHMC) Cultural Resource Notice. The PHMC advises and assists federal and State agencies in completing its responsibilities set forth in Section 106 of the National Historic Preservation Act and the Pennsylvania History Code. The consultation/coordination process facilitates a review of potential project-related impacts on known resources listed on the State and National Register of Historic Places, as well as potential impacts on unknown cultural and/or archaeological resources in areas identified as sensitive to the presence of such resources. The process is initiated by the submission of a review form and supporting documentation to the PHMC (see Appendix IV.A.6-G). Supporting documentation may include a record of disturbance form.

Known cultural resources are illustrated on Figure 1.4. The information is based on a PHMC database that can be found on the internet at

[9] No impact is anticipated to threatened and endangered species and/or special concern species and resources.
[10] No impacts to federally listed or proposed species are anticipated. Therefore, no further consultation/coordination under the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.* is required.

http://www.portal.state.pa.us/portal/server.pt/community/crgis/3802. The data indicates there are no known sites listed or eligible for listing on the State or National Registers of Historic Places located on or contiguous to the three alternative sites.

As a publicly-funded program, the project sponsor will be required to consult with the PHMC to obtain site clearance indicating the project will not adversely impact cultural resources. Consultation may involve a cultural resource investigation, or at a minimum documentation of significant prior on-site disturbance. Whereas Sites 1 and 3 are characterized as undeveloped sites with prior agricultural uses[11], portions of Site 2 have undergone extensive subsurface disturbance as a result of gravel/borrow pit operations.

IV.A.6.4 Permitting Schedule

Based on the information summarized in the preceding subsections, a GANTT chart has been prepared that illustrates approximate regulatory review timelines (based on anticipated permits and reviews) for each of the three alternative sites. The information, provided in Appendix IV.A.6-H, indicates that the shortest approval timeline is associated with Sites 1 and 3, which is based predominantly on the absence of wetlands and floodplains within the anticipated limits of construction, and the associated regulatory reviews.[12]

IV.A.6.5 Approvability

While the overall site selection will be based the balancing of a number of considerations, “approvability” (*i.e.*, the ability to obtain permits) should be an important element of that process. Approvability, as a process, is based on a number of tangible and intangible factors including:

- Number and type of permits
- Regulatory agency requirements
- Sufficiency of information
- Concerns, issues, and perceptions of decision-makers.

The analysis summarized below represents a “high altitude” review of the anticipated regulatory approval process associated with each site. General conclusions are based on an assumption that the level of information is relatively the same for each site, as outlined in other sections of this report.

[11] Agricultural activities (*i.e.*, disking of fields for cultivation) do not typically constitute sufficient subsurface disturbance to preclude a cultural resource investigation.
[12] Site control was not considered in the GANTT chart analysis, but should be a factor in the overall decision-making process. It is noted that Site No. 1 is publicly-owned, while Site Nos. 2 and 3 are held in the private sector.

Number and type of permits. As indicated on the tabular summary of potential permits (Appendix IV.A.6-A), Sites 1 and 3 have the same type and number of permits. Depending upon the limits of construction, Site 2 may also require acquisition of a federal wetland permit (United States Army Corps of Engineers, USACE) and/or local floodplain development permit.

Regulatory agency requirements. Regulatory agency requirements associated with permitting Sites1 and 3 are substantially similar. Applicable approvals are predominantly related to local zoning-related processes (*i.e.*, site plan approval, *etc.*). Consequently, approval of the project will likely be a locally lead/controlled endeavour.

Depending upon the limits of construction and presence of federally regulated wetlands, Site 2 may require review and approval by the USACE. The addition of the USACE as part of the right-to-build permitting process adds discretionary authority, which will likely influence design, cost, and schedule. For example, if the site layout encroaches upon federal wetlands, the USACE will require that the site layout represent the “Least Environmentally Damaging Practicable Alternative” (LEDPA); the USACE will not issue a permit if there is a known lesser impacting practicable alternative. In addition, for permanent wetland encroachments (*i.e.*, resulting in the loss of wetlands, functions and values), the USACE will likely require design, approval, implementation, and monitoring of a compensatory mitigation plan.

Sufficiency of information. Certain sites may require the compilation and/or development of additional data and information. Proximity to sensitive receptors may require additional reviews (*i.e.*, noise assessment, visual assessment, *etc.*). The location of some sites may require a more detailed review of stormwater or traffic. Due to the proximity of the sites to each other, the significance of this consideration may be minimized; and for the purposes of this assessment, the sufficiency of information was considered to be the same for each site.

Decision-maker perceptions. While tangible considerations in the permitting process are more often focused upon (see above), intangible considerations such as decision-maker opinions and perceptions can often be the stumbling blocks to moving programs forward. Based on the information reviewed, as well as the proximity of the sites to each other, it is assumed that decision-maker perceptions of the project regardless of the site are similar. Decision-maker perceptions of each individual site are currently unknown. Regardless of the site selected, it will be important to engage decision-makers and other stakeholders early in the process to understand potential project or site specific concerns and issues, compile the necessary information to understand issues and alleviate concerns, and appropriately mitigate potential adverse impacts.

IV.A.7 Capital Cost Estimate

The capital costs for the different parts of the project are shown in **Table IV.A.7-1**. Detailed information for investment costs could also be found in **Annex IV.A.8-A**.

Table IV.A.7-1: Project Capital Cost

Cost Position	Investment Costs
1. Technology	
Biomass Heat and Power Plant (Variant 3)[13]	22,236,997 USD
Distribution System pipe construction (Best Case)[14]	19,765,180 USD
Domestic hot water preparation storage charging system[14]	2,370,160 USD
Customer interface compact-station[14]	3,394,180 USD
Pressure Maintenance[14]	112,200 USD
Circulating pumps[14]	538,500 USD
2. Real Estate	200,000 USD
3. Construction[13]	
Buildings[13]	3,749,915 USD
Civil engineering + outside facilities[13]	925,000 USD
Utilities[13]	850,360 USD
4. Engineering Services	
Biomass Heat and Power Plant (Variant 3)[13]	1,664,962 USD
District Heating Network (complete)[14]	2,618,022 USD
Design and Construction Management Services**Fehler! Textmarke nicht definiert.**	177,536 USD
6. Others	
Contingency Allowance**Fehler! Textmarke nicht definiert.**	177,536 USD
Contingency Biomass Plant + District Heating Network	1,469,514 USD
Total	**60,250,062 USD**

[13] See Annex IV.A.3-A - Financial Analyses Var3.pdf and Annex IV.A.5.
[14] See chapter IV.A.2.3. Values for best case.

IV.A.8 Financial Analysis

After termination of the examinations concerning the district heating network and the biomass CHP plant, the project was analyzed regarding its financial viability by the means of a financial analysis.

The purpose of the financial analysis was to establish the financial yield of the project. Hence, it addresses the revenue structure of the project from the point of view of an equity investor and the bankability of the project. In addition to the project costs, the financial analysis also took financing costs into consideration.

For the execution of the financial analysis a purpose-fit spreadsheet model (feasibility level) – based on models developed at Lahmeyer International for project appraisal – was fleshed out.

IV.A.8.1 Input Data

Essential input data is shown in the following section.

IV.A.8.1.1 Investment Costs

The Investment Costs were taken from **Chapter IV.A.7** and could also be in **Annex IV.A.8-A**.

IV.A.8.1.2 Time assumptions

- Project Start: 2011
- Project lifetime: 30 years

Due to the life time of the district heating network, a minimum project lifetime of 30 years was assumed. For the biomass CHP plant a general overhaul after 15 years is planned with 100% of the investment costs. This means that the costs of a complete new biomass CHP plant set.

- Project end: 2041

IV.A.8.1.3 Economics

Currency

- Euro/USD rate: One Euro equals 1.5 USD (fixed)

Subsidies

- Applied Subsidy: 5.5 Mio. USD (already requested)
- Tax Credit: 30% of investment for biomass CHP plant (but not for district heating network)

Escalation rates

- Annual price rise: 0%
- Inflation: 0%

Weighted average cost of investment (WACC)

- WACC: 6.84% (calculated)

Tariffs and prices

- Power feed-in tariff: 0.13 USD/kWh (including rights on RECs)
- Price per REC: 0.0 USD/kWh
- Power supply: 0.08 USD/kWh

Biomass CHP plant

- Wood chip price: 35 USD/t (2.3 kWh/t; including transportation)
- Ash disposal: 45 USD/t (grate and fly ash; including transportation)
- Water treatment: 6 USD/m³

Wages

- Average wage: 60,000 USD/a per employee

Detailed input data for the financial analyses could be found in **Annex IV.A.8-B**.

IV.A.8.2 Outcomes

Besides the investigation of the annual costs of the project, the main objective of this analysis was the determination of the specific heat costs (in USD/MWh). This parameter was determined assuming a granted income for electricity generated by the plant and the expected profitability of the project from the investor's point of view, based on minimum expectations for financial indicators as the project internal rate of return (IRR) and return on equity (ROE).

Table IV.A.8-1 shows the values for spec. heat costs, Internal Rate of Return (IRR; pre tax) and Return on Equity (ROE) as the major outcomes of the financial analyses of the feasibility study.

Table IV.A.8-1: Major outcomes of Financial Analyses

Specific heat costs	83 USD/MWh

Project IRR (pre tax)	6.84%
ROE	18%

The most important input values and assumptions were varied to show their influence on the economy of the project.

Table IV.A.8-2: Sensitivity Analyses Specific Heat Costs Biomass CHP Plant [USD/MWh]

Variation	-20%	-10%	+/- 0%	+10%	+20%
Wood Chip Price	68	75	83	91	98
Power Feed in tariff	114	99	83	68	52
Investment costs			83		
Subsidies			83		
Major Overhaul			83		
(Properties)			83		

Main outcomes of the financial analyses appear in **Annex IV.A.8-C - Operational Revenues and Costs** and in **Annex IV.A.8-D – Cash Flow Statement.**

IV.A.8.3 Conclusions and Recommendations

Besides the investigation of the annual costs of the project, the main objective of this analysis was the determination of the specific heat costs (or initial heat costs; in USD/MWh). This parameter was determined assuming a granted income for electricity generated by the plant and the expected profitability of the project from the investor's point of view, based on minimum expectations for financial indicators as the project internal rate of return (IRR) and return on equity (ROE).

This value calculated for the specific heat costs in line with this analysis will be the minimum amount to cover all of the occurring costs while satisfying the investor's expectations on project profitability.

In the next phase of the project, after termination of the feasibility study, the ascertained average specific costs for the heat from the biomass CHP plant should be compared with the real specific heat costs of each single property or property group of Smethport.

To give an idea for this comparison, the specific heat costs for an average residential house in Smethport were calculated, since residential buildings are the dominant building group in Smethport. The calculation was done for an existing house (only variable and fixed costs) and for the assumption of installing a new heating facility (additionally capital costs).

Table IV.A.8-3: Typical characteristics for an average residential house in Smethport

Specific heat costs - New	100 USD/MWh
Specific heat costs - Old	70 USD/MWh
Square footage	150 m²
Annual heat demand	30,000 kWh/a

The results for a typical residential house in Smethport are 70 USD/MWh for an existing and 100 USD/MWh for a new heating facility. Assuming that all residential houses in Smethport will be in the situation that they will have to replace their existing heating facility in the next thirty years, it seems that the price to beat is the 100 USD/MWh for a new heating facility. Against this background the calculated specific heat costs for the biomass CHP plant of 83 USD/MWh look competitive.

V Recommendations

V.A Recommended Plan

V.B Project Implementation

V.C Project Schedule

The detailed preliminary project schedule could be found in Annex V.C Project Schedule 11_12_09.pdf.

Annex IV.A.2-A

1,100 550 0 1,100 Feet

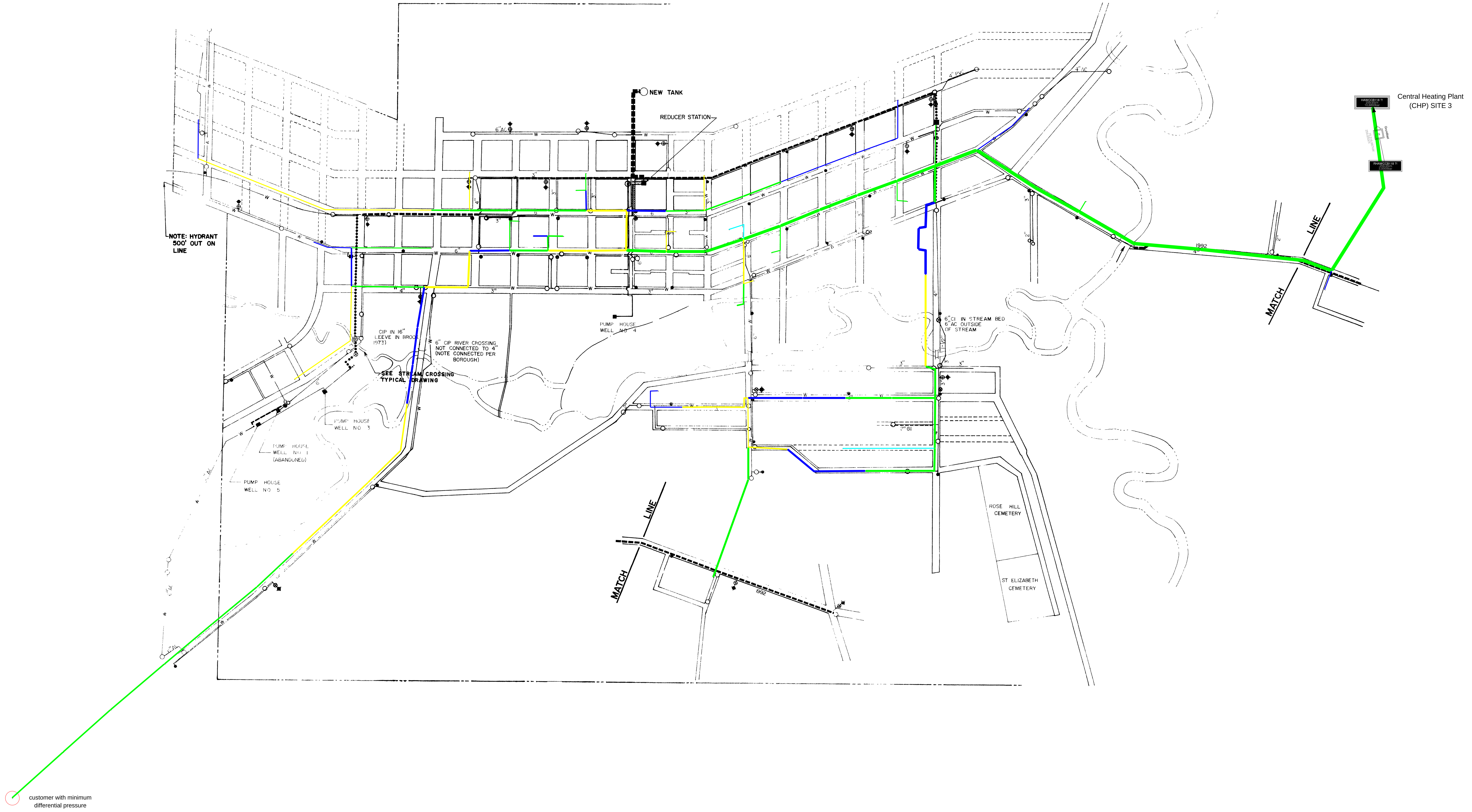
Annex 3.3-1

Annex 3.3-2

No.	Name	Type	Connected load [BTU/hr]
1	R.D.J. Catalog, Inc.	County building	40,982
2	McKean County Court	County building	1,881,764
3	McKean County Jail	County building	1,243,125
4	S.A. School District	County building	5,266,206
5	911	County building	61,473
6	CYS	County building	81,964
7	AJTFP, LP	County building	47,813
8	Bowman Health Center	County building	160,513
9	Penn State Extension	County building	177,589
10	Planning	County building	126,362
11	Old Sena-Kean Manor	Major customer	1,830,536
12	St. Luke’s Church	Major customer	1,499,264
13	United Methodist Church	Major customer	1,034,799
14	Lakeview Care Center	Major customer	751,339
15	Intermediate Unit Nine	Major customer	693,281
16	St. Elizabeth’s Church	Major customer	662,545
17	Troy M. Herzog	Major customer	638,638
18	Historical Society	Major customer	614,732
19	Christian Church	Major customer	624,978
20	Housing Dickinson Man	Major customer	525,938
21	Pot_01	Summarized consumer	850,380
22	Pot_02	Summarized consumer	788,906
23	Pot_03	Summarized consumer	918,683
24	Pot_04	Summarized consumer	853,795
25	Pot_05	Summarized consumer	1,103,103
26	Pot_06	Summarized consumer	932,344
27	Pot_07	Summarized consumer	1,711,005
28	Pot_08	Summarized consumer	853,795
29	Pot_09	Summarized consumer	1,338,750
30	Pot_10	Summarized consumer	539,598
31	Pot_11	Summarized consumer	1,226,049
32	Pot_12	Summarized consumer	488,371
33	Pot_13	Summarized consumer	911,853
34	Pot_14	Summarized consumer	1,000,647
35	Pot_15	Summarized consumer	1,922,746
36	Pot_16	Summarized consumer	761,585
37	Pot_17	Summarized consumer	1,270,447
38	Pot_18	Summarized consumer	2,025,201
39	Pot_19	Summarized consumer	689,866
40	Pot_20	Summarized consumer	669,375
41	Pot_21	Summarized consumer	3,312,724
42	Pot_22	Summarized consumer	928.929
43	Pot_23	Summarized consumer	1.277.277
44	Pot_24	Summarized consumer	3.497.143
45	Pot_25	Summarized consumer	1,133,839
46	Pot_26	Summarized consumer	560,089
47	Pot_27	Summarized consumer	1,441,206
48	Pot_28	Summarized consumer	689,866
49	Pot_29	Summarized consumer	2.230.112
50	Pot_30	Summarized consumer	1,000,647
51	Pot_31	Summarized consumer	1,642,701
52	Pot_32	Summarized consumer	587,411
53	Pot_33	Summarized consumer	788,906
54	Pot_34	Summarized consumer	276,630
55	Pot_35	Summarized consumer	887,947
56	Pot_36	Summarized consumer	638,638
57	Pot_37	Summarized consumer	1,024,554
58	Pot_38	Summarized consumer	966,496
59	Pot_39	Summarized consumer	184,420
60	Pot_40	Summarized consumer	368,839
61	Pot_41	Summarized consumer	92,210
62	Pot_42	Summarized consumer	396,161
	Total		**62,747,084**

Annex 3.3-3

No.	**Name**	**Connected load [BTU/hr]**	**Costs for Compact-station [$]**
1	R.D.J. Catalog, Inc.	40,982	3,000
2	McKean County Court	1,881,764	25,886
3	McKean County Jail	1,243,125	22,040
4	S.A. School District	5,266,206	46,130
5	911	61,473	3,000
6	CYS	81,964	5,285
7	AJTFP, LP	47,813	3,000
8	Bowman Health Center	160,513	9,872
9	Penn State Extension	177,589	10,570
10	Planning	126,362	7,878
11	Old Sena-Kean Manor	1,830,536	25,752
12	St. Luke’s Church	1,499,264	23,910
13	United Methodist Church	1,034,799	20,519
14	Lakeview Care Center	751,339	18,449
15	Intermediate Unit Nine	693,281	18,025
16	St. Elizabeth’s Church	662,545	17,649
17	Troy M. Herzog	638,638	17,300
18	Historical Society	614,732	16,951
19	Christian Church	624,978	17,101
20	Housing Dickinson Man	525,938	15,655
	miscellaneous	< 68,300	1,551,000
	miscellaneous	68,300 – 170,760	1,032,102
	miscellaneous	> 170,760	483,106
	Total	**62,747,084**	**3,394,180**



090924 Smethport
best case

Knoten: 200 Leitungen: 200
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Benutzer: kerstin.bohn
P:\V-LI-001\07Berechnungen\Stanet\best_case\
090924 Smethport

Netzbezeichnung:
Netzmedium: F
Netzvolumen (Ende): 341,4 Nm3

Leitungen:
Reibungsverl./km(mbar/km)

- 10000.00
- 1500.00 - 10000.00
- 900.00 - 1500.00
- 500.00 - 900.00
- 100.00 - 500.00
- 0.00 - 100.00
- 0.00

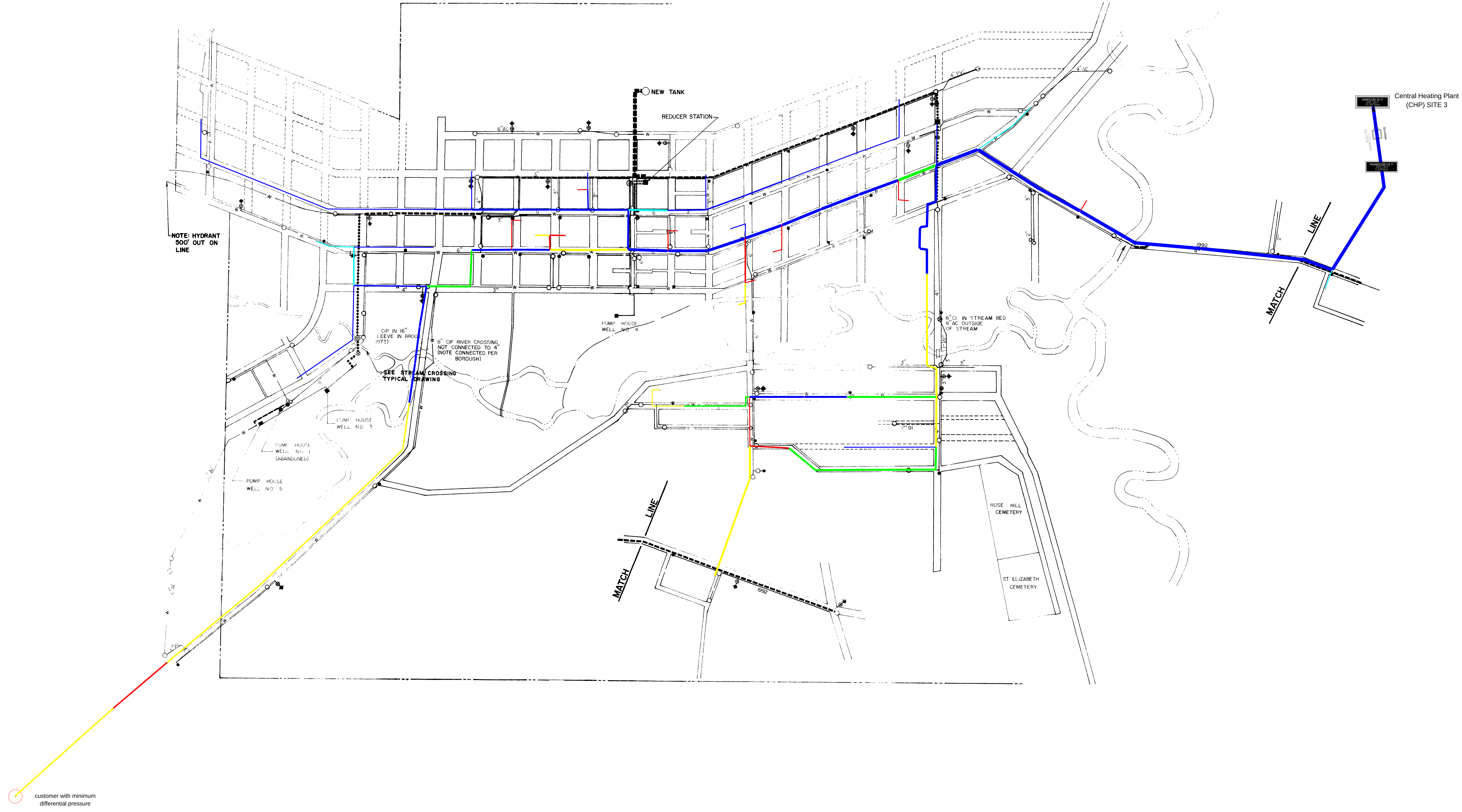
Innendurchm.(mm)

- 224.0 - 263.0
- 185.0 - 224.0
- 146.1 - 185.0
- 107.1 - 146.1
- 68.1 - 107.1
- 29.1 - 68.1

Wärmetauscher:
Delta p(bar)

- 1.0010 - 7.0798
- 1.0000 - 1.0010

						Maßstab 1:3579
						Annex 3.3-4a
					Datum	Name	best case
				Bearb.	25.11.09	Bohn GEF	
				Gepr.			
				Norm			
						results of the hydraulic network calculation
Zust.	Änderung	Datum	Name			



091119 Smethport
worst case

Knoten: 200 Leitungen: 200
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Benutzer: kerstin.bohn
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091119 Smethport

Netzbezeichnung:
Netzmedium: F
Netzvolumen (Ende): 341,4 Nm3

Leitungen:
Reibungsverl./km(mbar/km)

- 10000.00
- 1500.00 - 10000.00
- 900.00 - 1500.00
- 500.00 - 900.00
- 100.00 - 500.00
- 0.00 - 100.00
- 0.00

Innendurchm.(mm)

- 224.0 - 263.0
- 185.0 - 224.0
- 146.1 - 185.0
- 107.1 - 146.1
- 68.1 - 107.1
- 29.1 - 68.1

Wärmetauscher:
Delta p(bar)

- 1.0010 - 6.9854
- 1.0000 - 1.0010

						Maßstab 1:3491
						Annex 3.3-4b
					Datum	Name	worst case
				Bearb.	25.11.09	Bohn GEF	
				Gepr.			
				Norm			
						results of the hydraulic network calculation
Zust.	Änderung	Datum	Name			

Annotation to Annex 3.3-4a and 3.3-4b

1. The different pipe colors describe the specific pressure loss in mbar/km.

   1 mbar/km = 571 PSI/in

2. The different line widths describe the inner diameter in mm.

   1 mm = 0.039 in

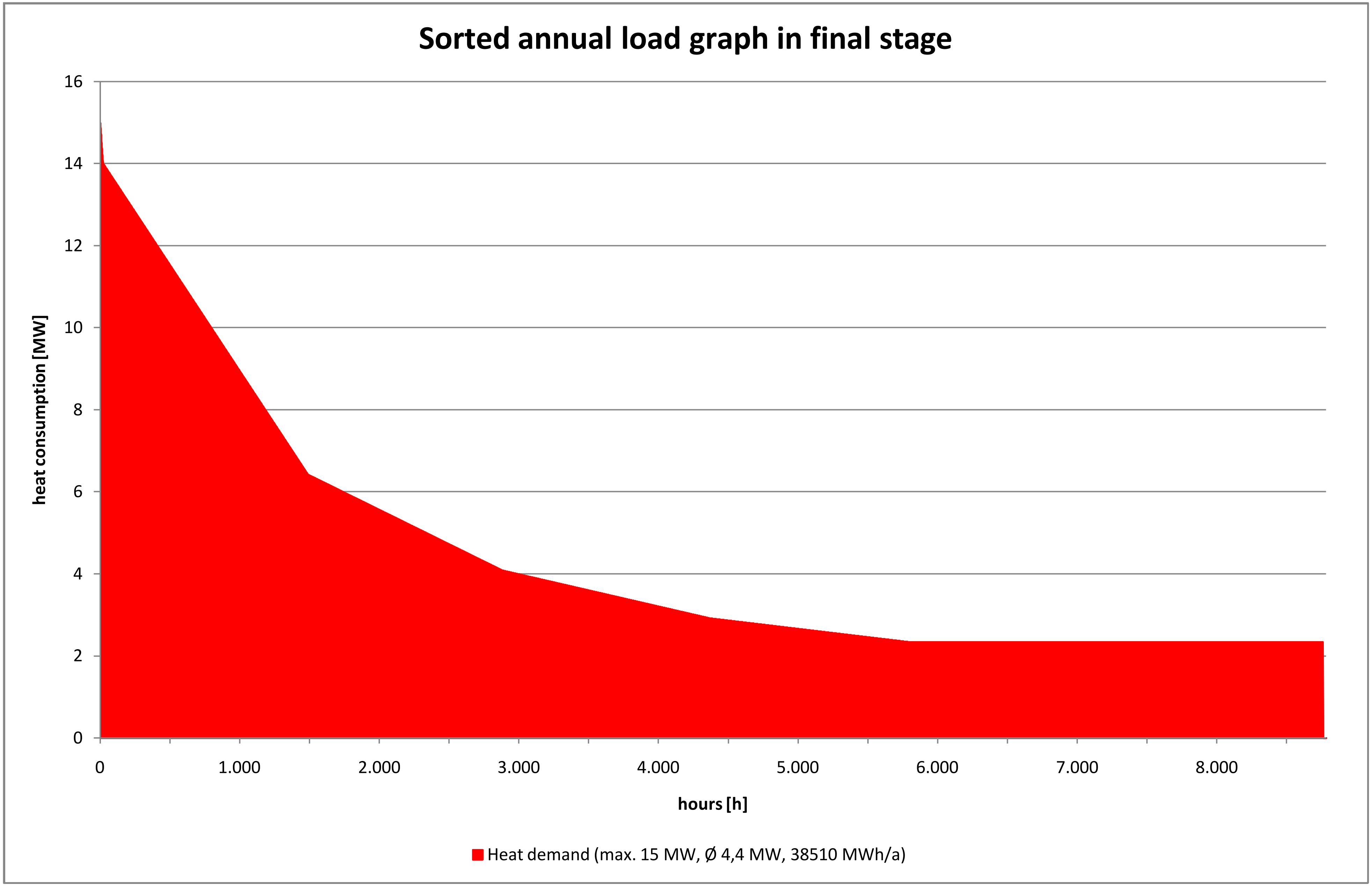
3. The red circle shows the location of the customer with the minimum differential pressure of 14.5 PSI.

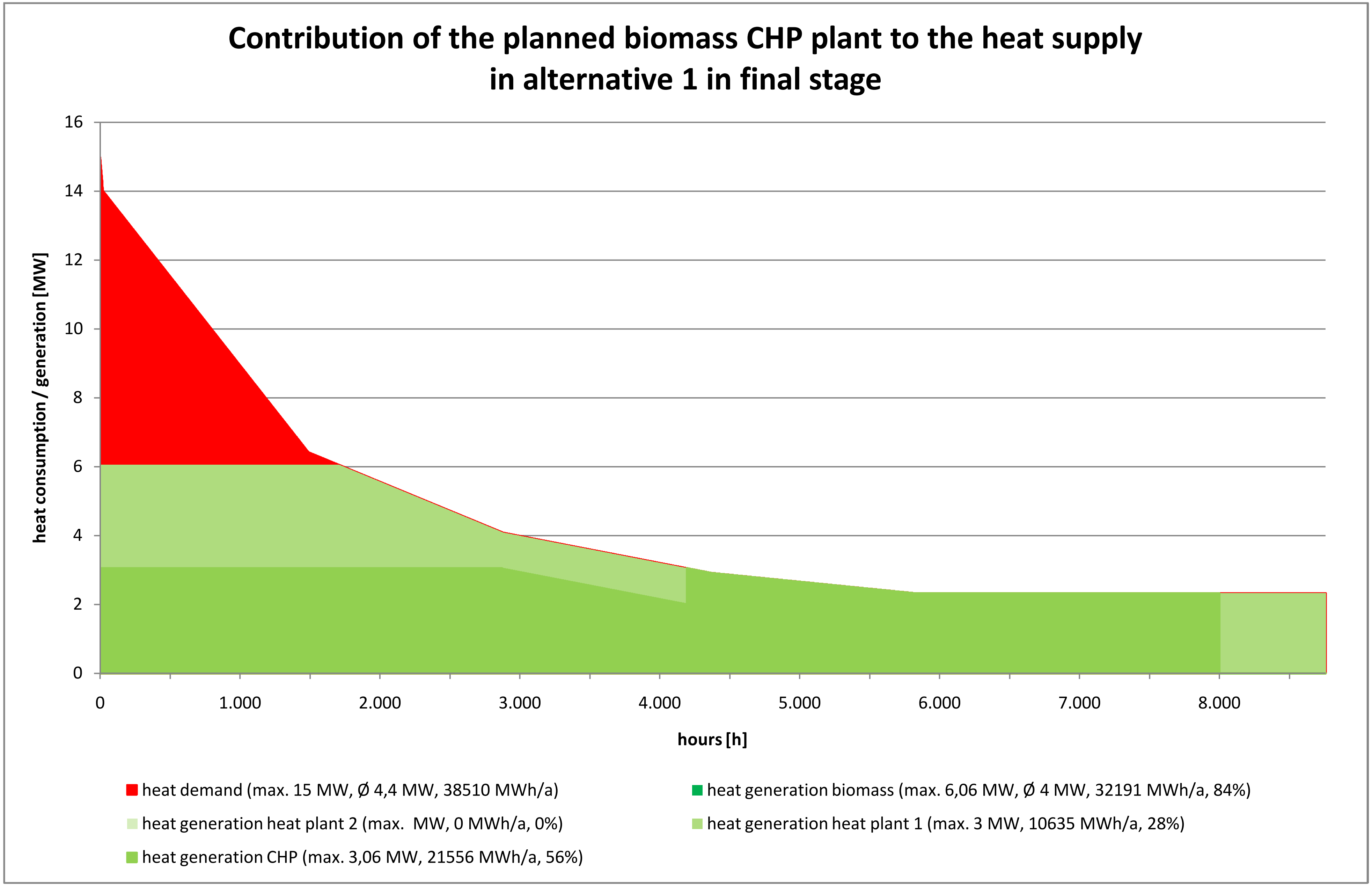
4. Node HAWCCB118 (supply) and RHAWCCB118 (return) comprehend the outgoing pressure, the return pressure [bar] and mass flow [t/h].

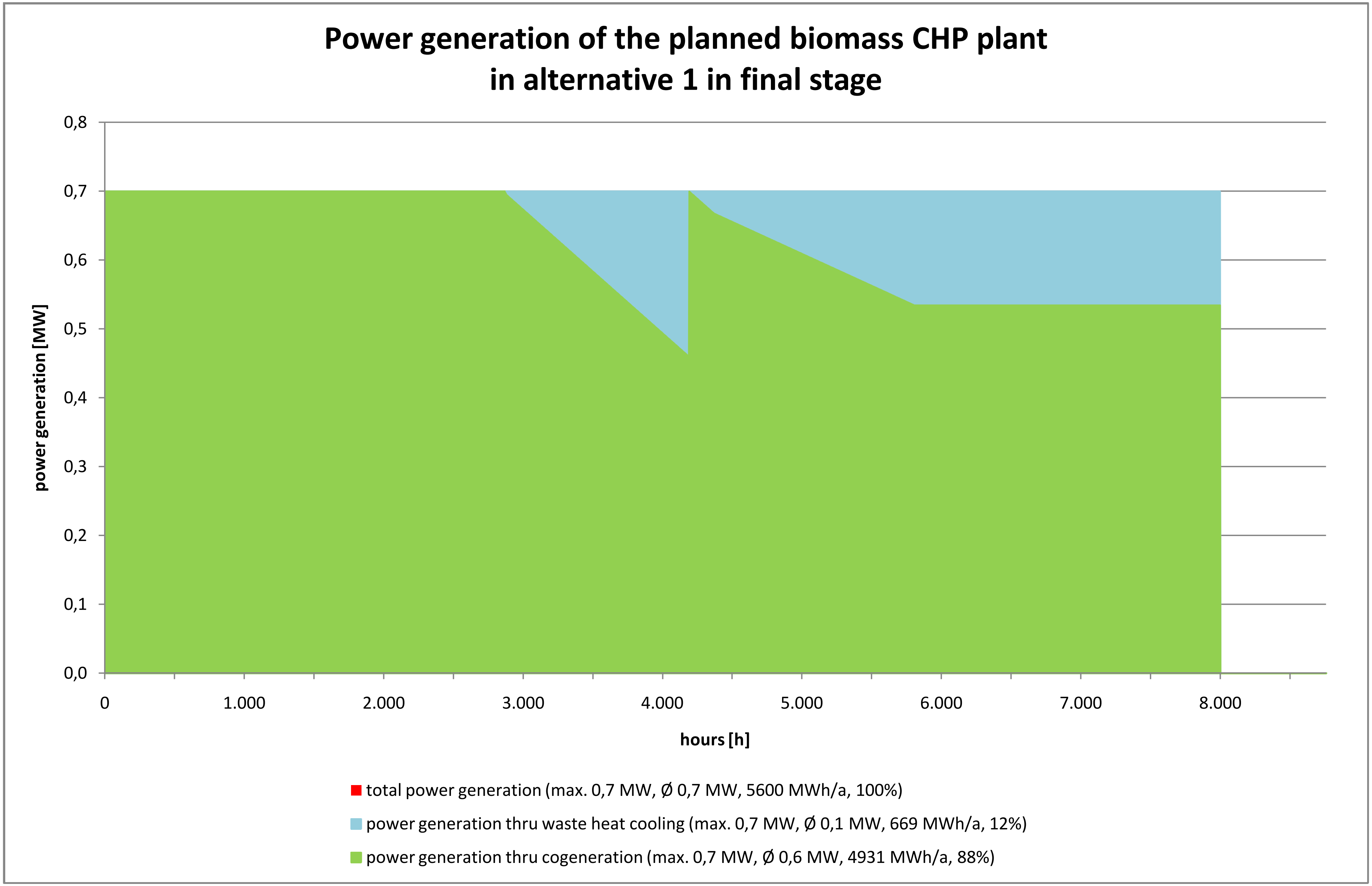
   1 bar = 14.5 PSI
   1 t/h = 264 gal/hr

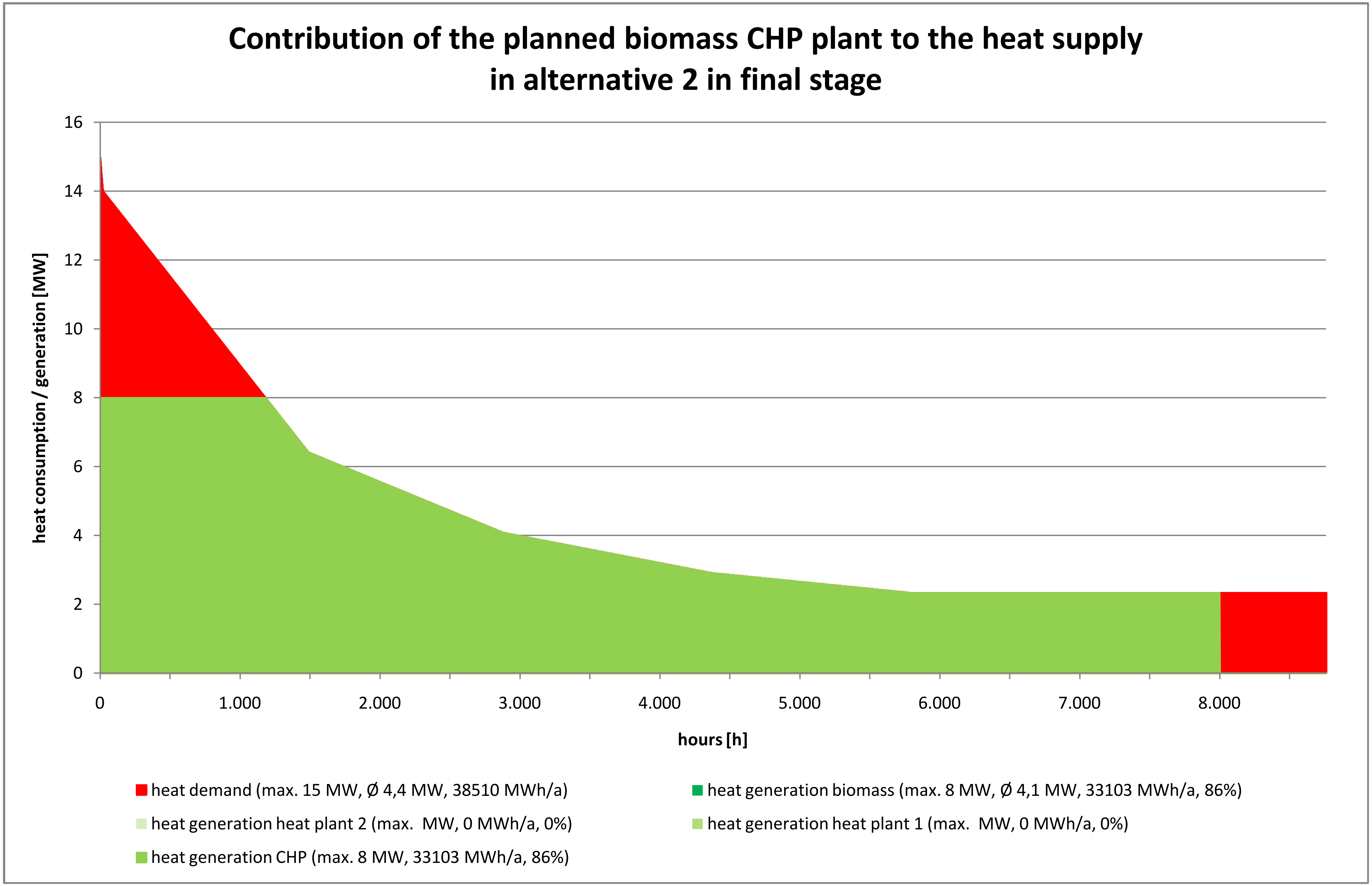
Annex IV.A.3-A

Basic Information

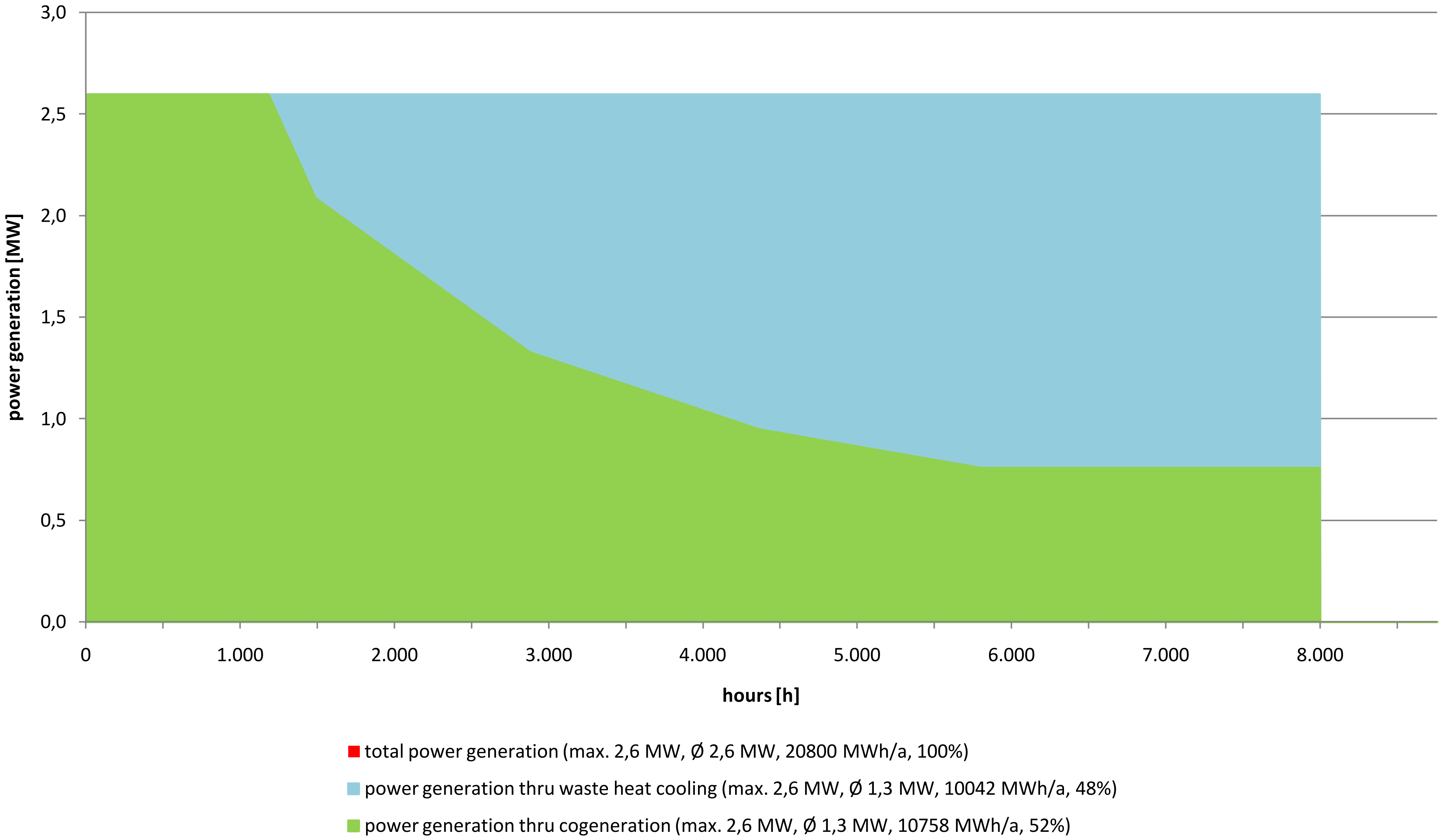

Sorted annual load graph in final stage
16
14
12
10
8
6
4
2
0
heat consumption [MW]
0
1.000
2.000
3.000
4.000
5.000
6.000
7.000
8.000
hours [h]
Heat demand (max. 15 MW, Ø 4,4 MW, 38510 MWh/a)

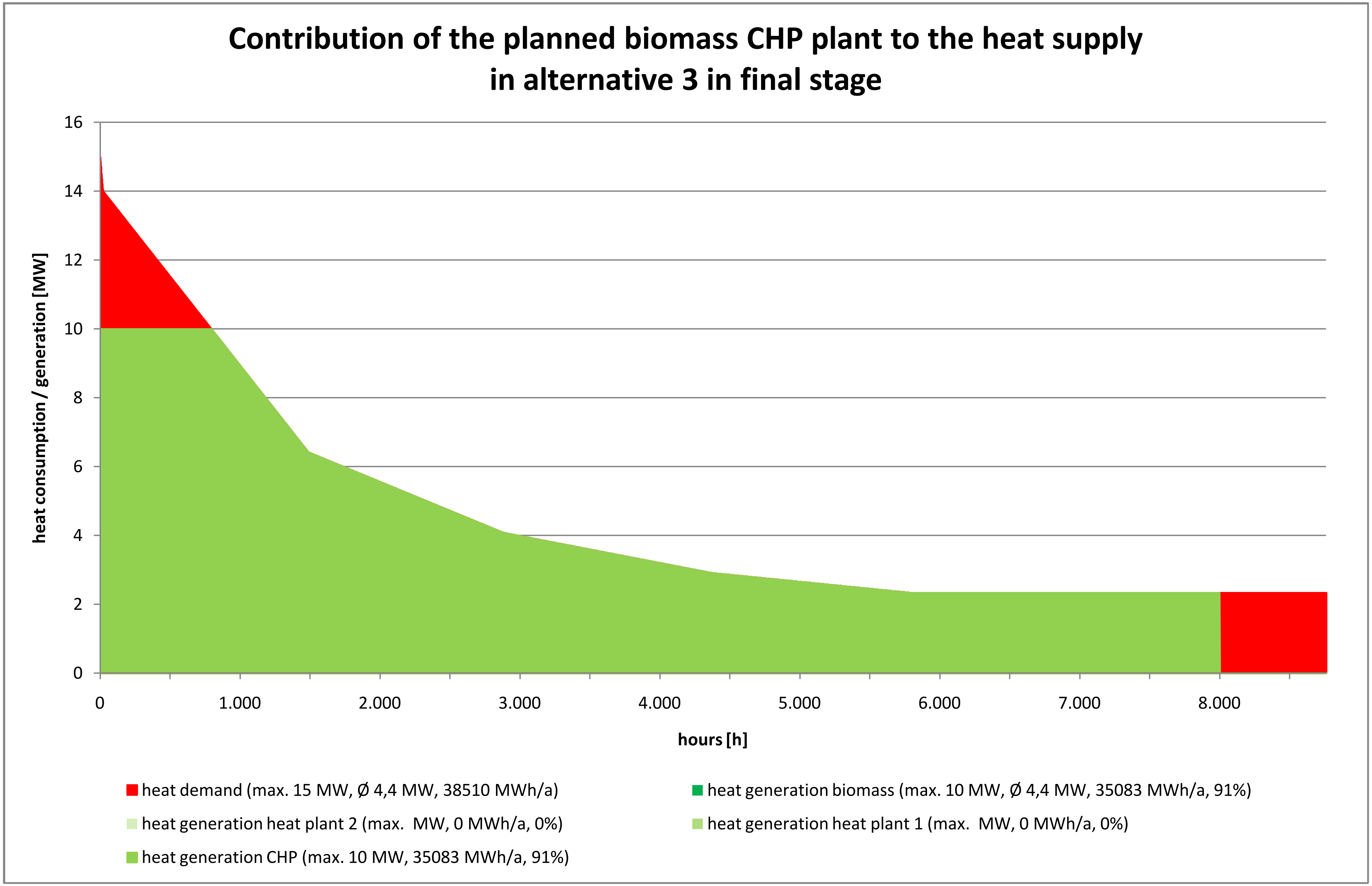

Contribution of the planned biomass CHP plant to the heat supply
in alternative 1 in final stage
heat consumption / generation [MW]
16
14
12
10
8
6
4
2
0
0
1.000
2.000
3.000
4.000
5.000
6.000
7.000
8.000
hours [h]
heat demand (max. 15 MW, Ø 4,4 MW, 38510 MWh/a)
heat generation biomass (max. 6,06 MW, Ø 4 MW, 32191 MWh/a, 84%)
heat generation heat plant 2 (max. MW, 0 MWh/a, 0%)
heat generation heat plant 1 (max. 3 MW, 10635 MWh/a, 28%)
heat generation CHP (max. 3,06 MW, 21556 MWh/a, 56%)


Power generation of the planned biomass CHP plant
in alternative 1 in final stage
0,8
0,7
0,6
0,5
0,4
0,3
0,2
0,1
0,0
power generation [MW]
0
1.000
2.000
3.000
4.000
5.000
6.000
7.000
8.000
hours [h]
total power generation (max. 0,7 MW, Ø 0,7 MW, 5600 MWh/a, 100%)
power generation thru waste heat cooling (max. 0,7 MW, Ø 0,1 MW, 669 MWh/a, 12%)
power generation thru cogeneration (max. 0,7 MW, Ø 0,6 MW, 4931 MWh/a, 88%)

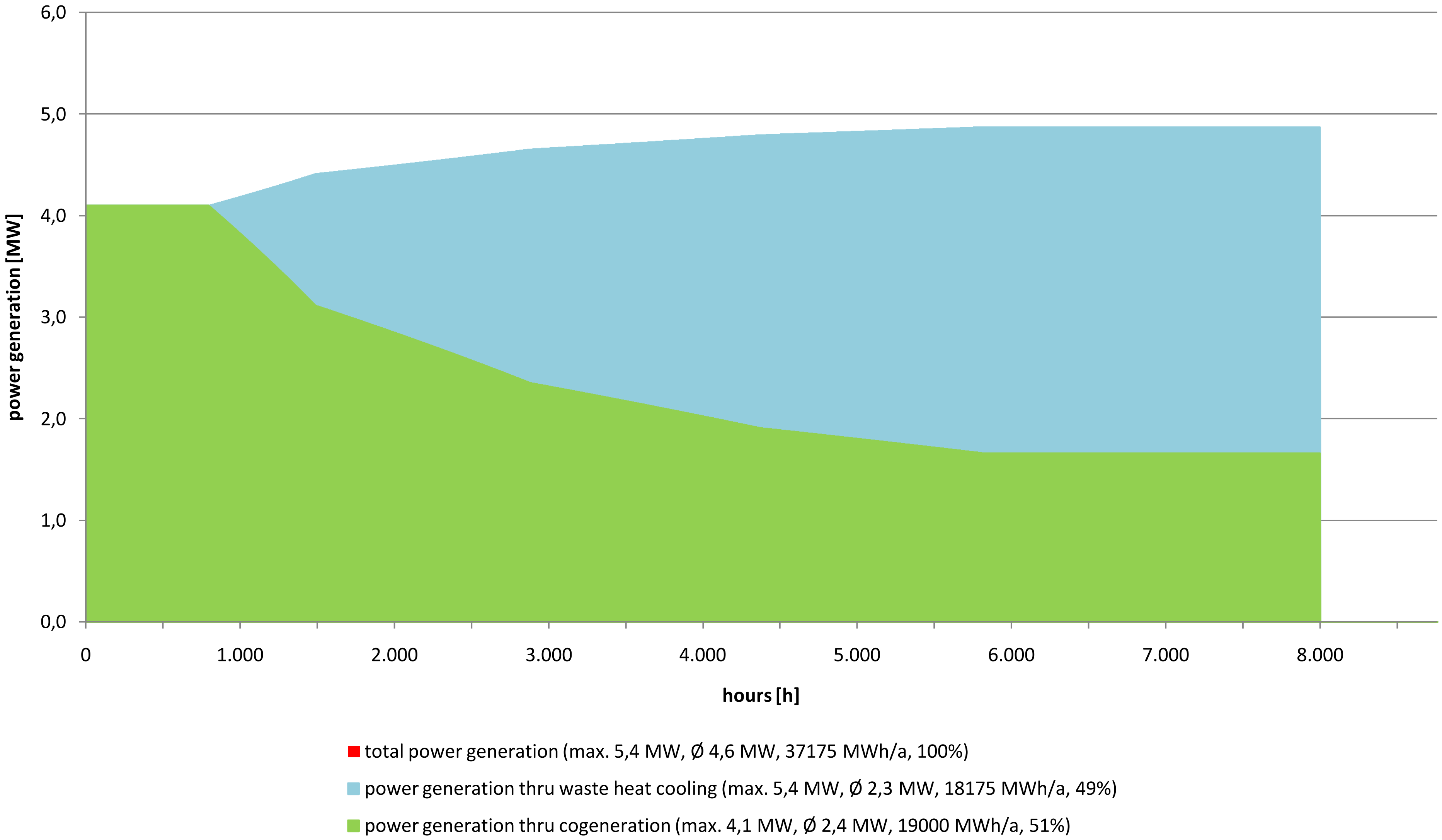

Contribution of the planned biomass CHP plant to the heat supply
in alternative 2 in final stage
heat consumption / generation [MW]
16
14
12
10
8
6
4
2
0
0
1.000
2.000
3.000
4.000
5.000
6.000
7.000
8.000
hours [h]
heat demand (max. 15 MW, Ø 4,4 MW, 38510 MWh/a)
heat generation biomass (max. 8 MW, Ø 4,1 MW, 33103 MWh/a, 86%)
heat generation heat plant 2 (max. MW, 0 MWh/a, 0%)
heat generation heat plant 1 (max. MW, 0 MWh/a, 0%)
heat generation CHP (max. 8 MW, 33103 MWh/a, 86%)

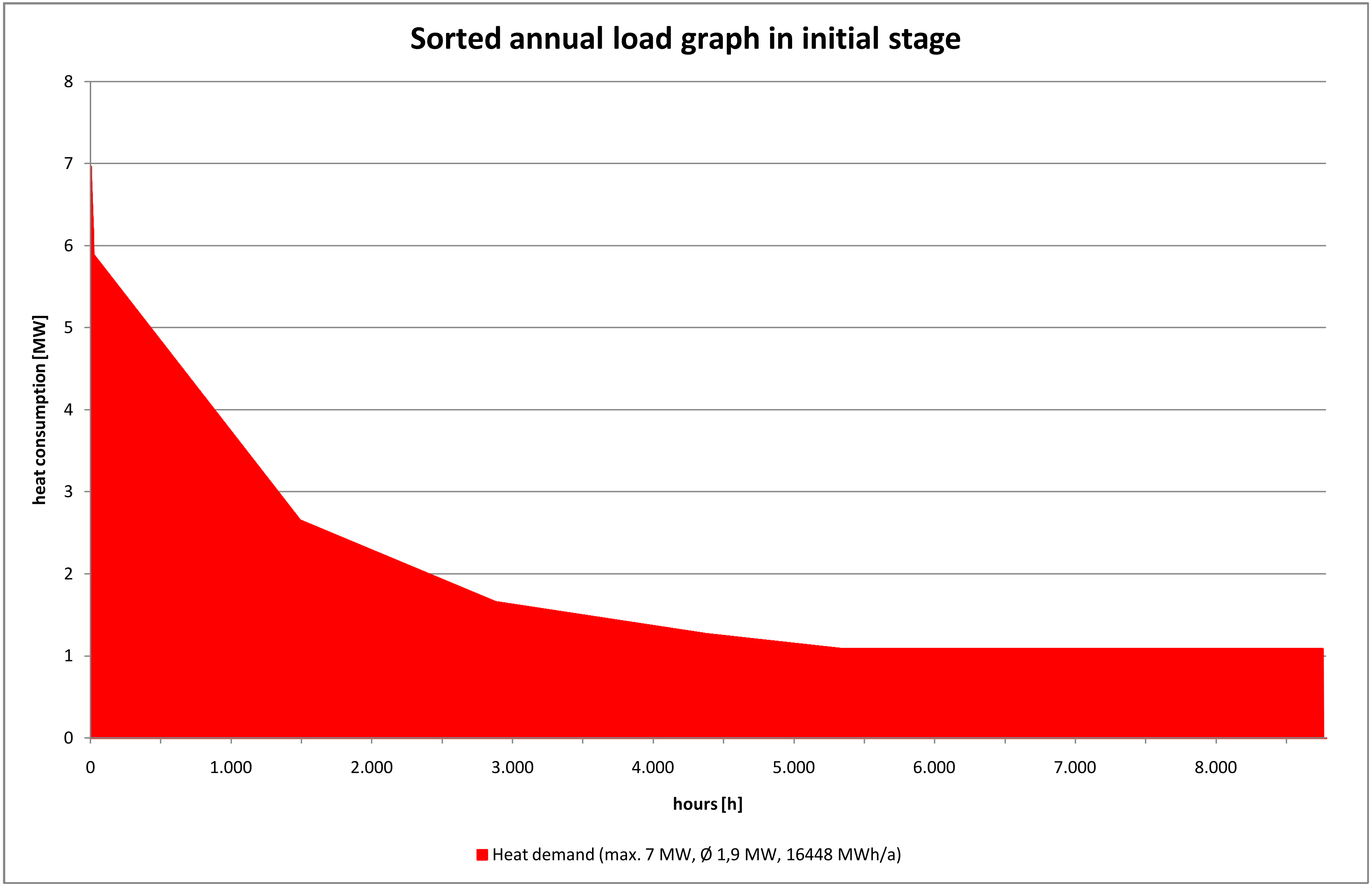
Power generation of the planned biomass CHP plant in alternative 2 in final stage

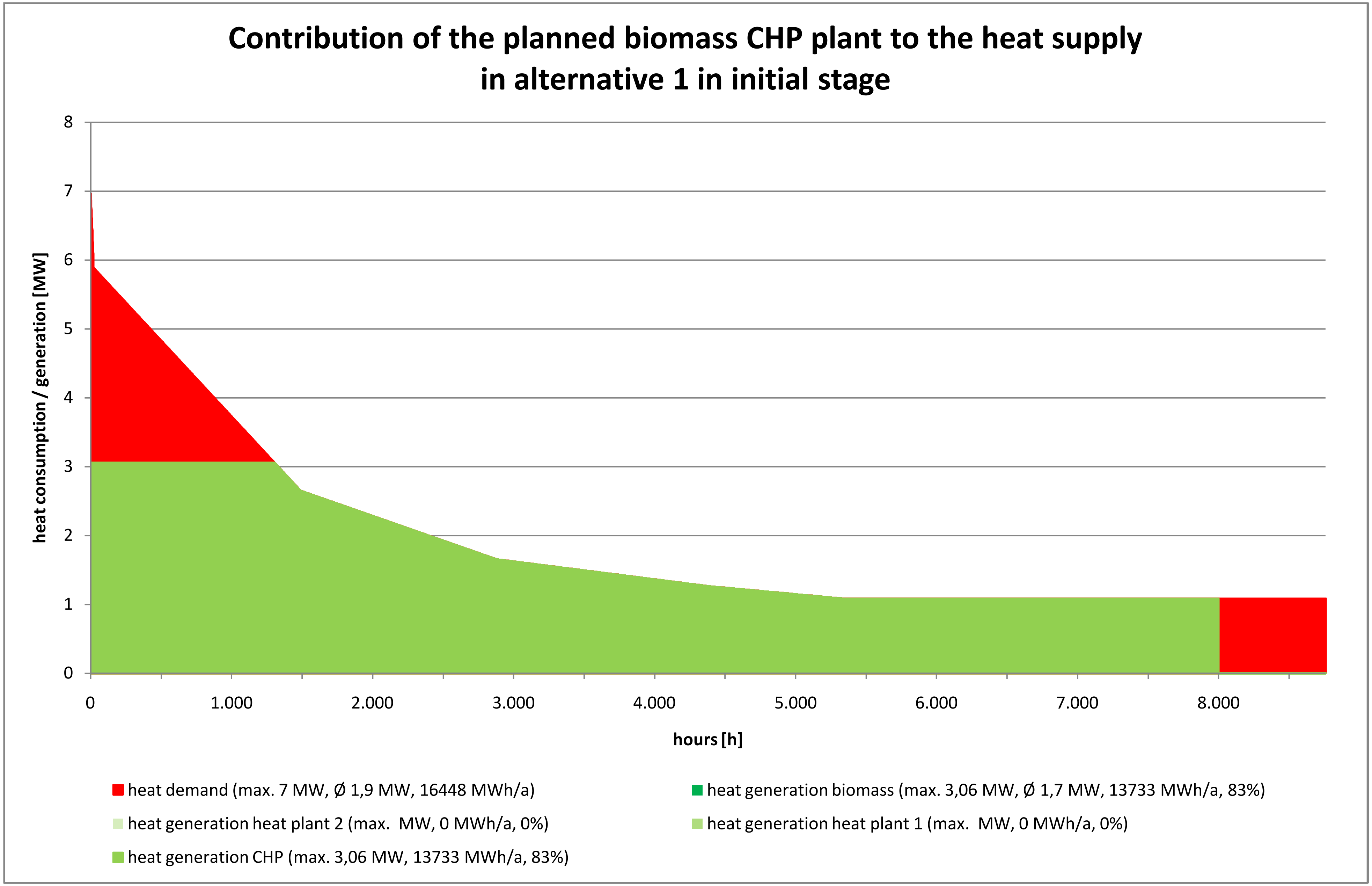


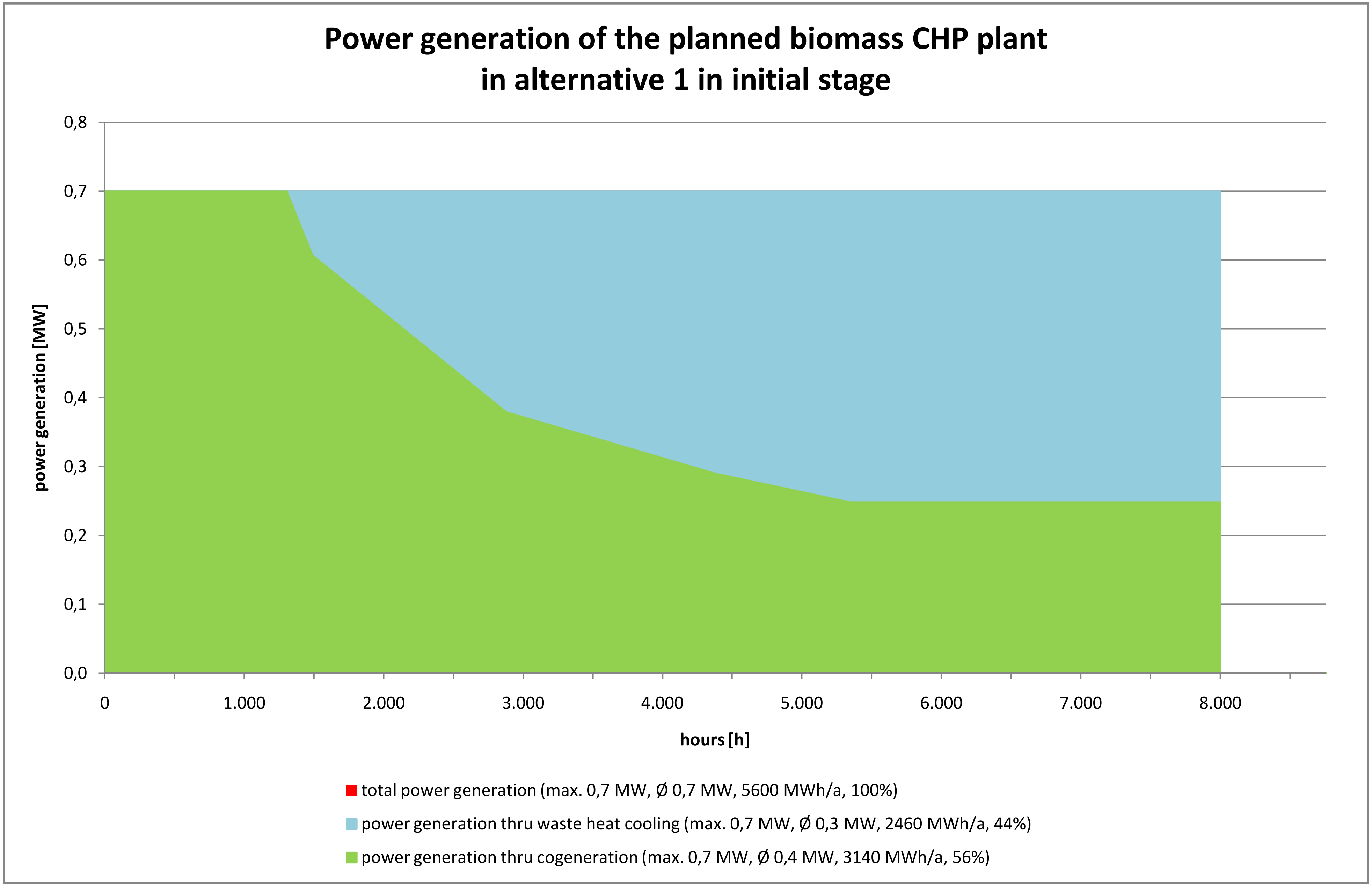

Contribution of the planned biomass CHP plant to the heat supply
in alternative 3 in final stage
heat consumption / generation [MW]
16
14
12
10
8
6
4
2
0
0
1.000
2.000
3.000
4.000
5.000
6.000
7.000
8.000
hours [h]
heat demand (max. 15 MW, Ø 4,4 MW, 38510 MWh/a)
heat generation biomass (max. 10 MW, Ø 4,4 MW, 35083 MWh/a, 91%)
heat generation heat plant 2 (max. MW, 0 MWh/a, 0%)
heat generation heat plant 1 (max. MW, 0 MWh/a, 0%)
heat generation CHP (max. 10 MW, 35083 MWh/a, 91%)

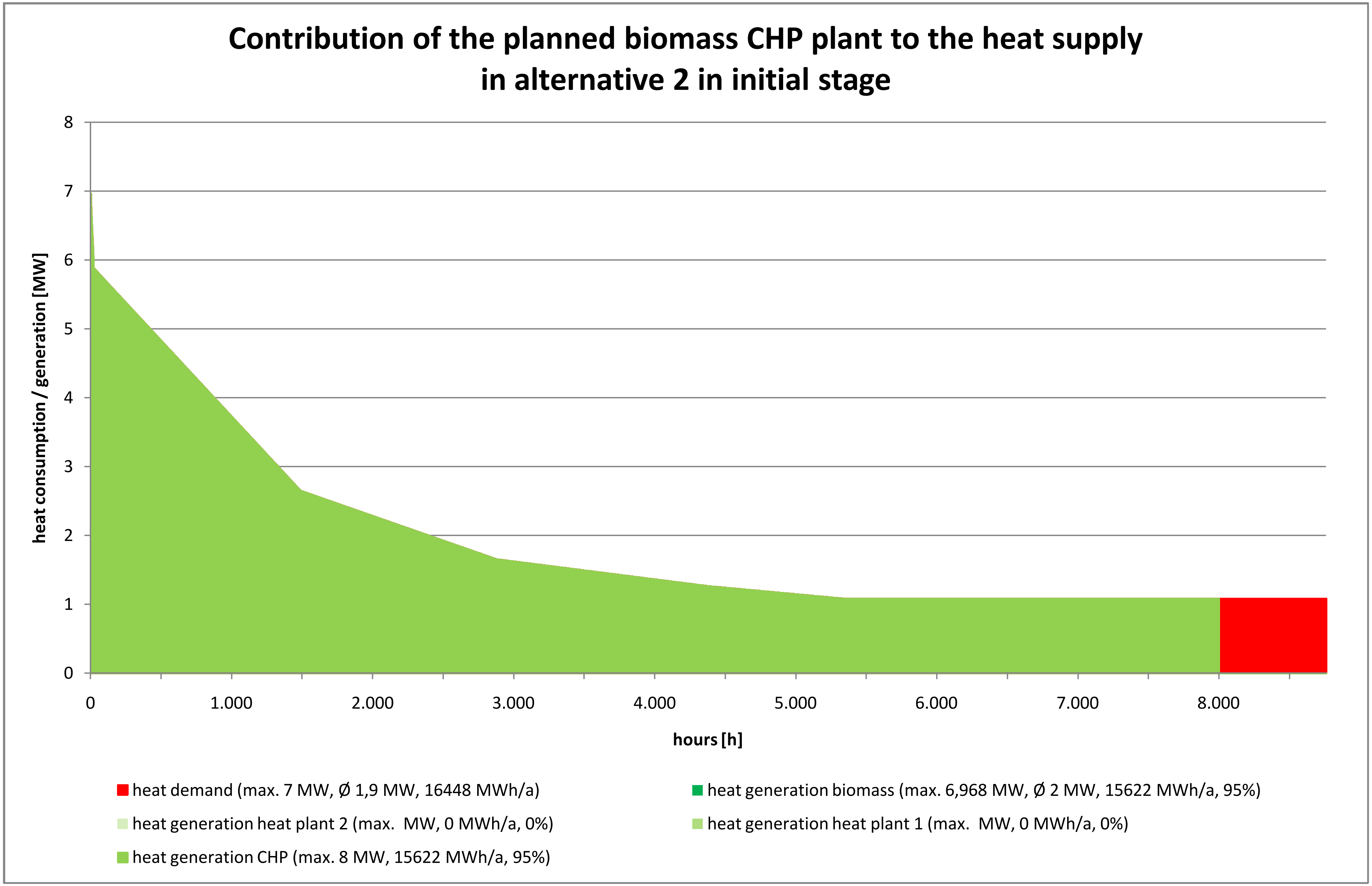
Power generation of the planned biomass CHP plant in alternative 3 in final stage



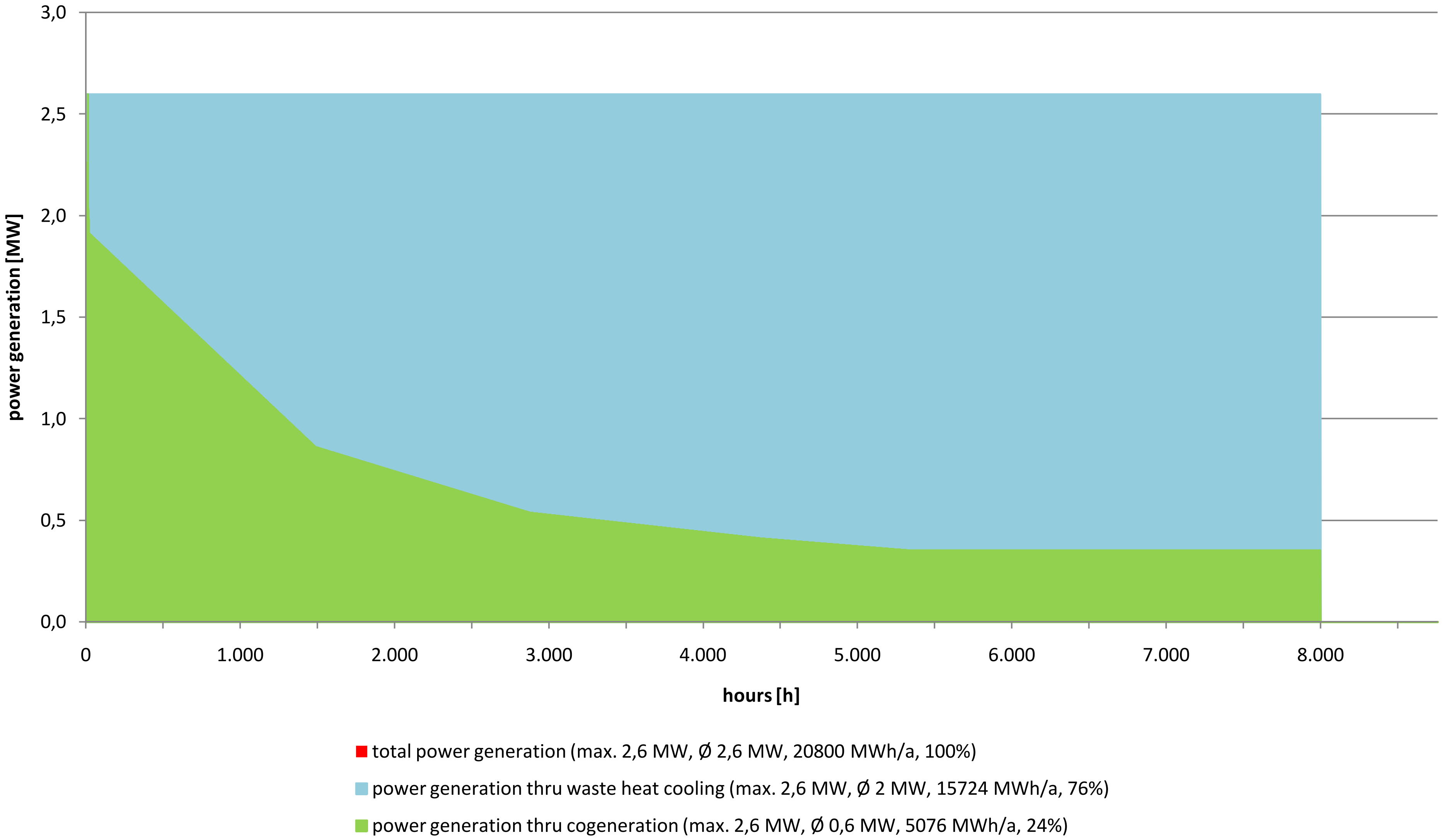

Sorted annual load graph in initial stage
heat consumption [MW]
8
7
6
5
4
3
2
1
0
0
1.000
2.000
3.000
4.000
5.000
6.000
7.000
8.000
hours [h]
Heat demand (max. 7 MW, Ø 1,9 MW, 16448 MWh/a)


Contribution of the planned biomass CHP plant to the heat supply in alternative 1 in initial stage
8
7
6
5
4
3
2
1
0
heat consumption / generation [MW]
0
1.000
2.000
3.000
4.000
5.000
6.000
7.000
8.000
hours [h]
heat demand (max. 7 MW, Ø 1,9 MW, 16448 MWh/a)
heat generation biomass (max. 3,06 MW, Ø 1,7 MW, 13733 MWh/a, 83%)
heat generation heat plant 2 (max. MW, 0 MWh/a, 0%)
heat generation heat plant 1 (max. MW, 0 MWh/a, 0%)
heat generation CHP (max. 3,06 MW, 13733 MWh/a, 83%)

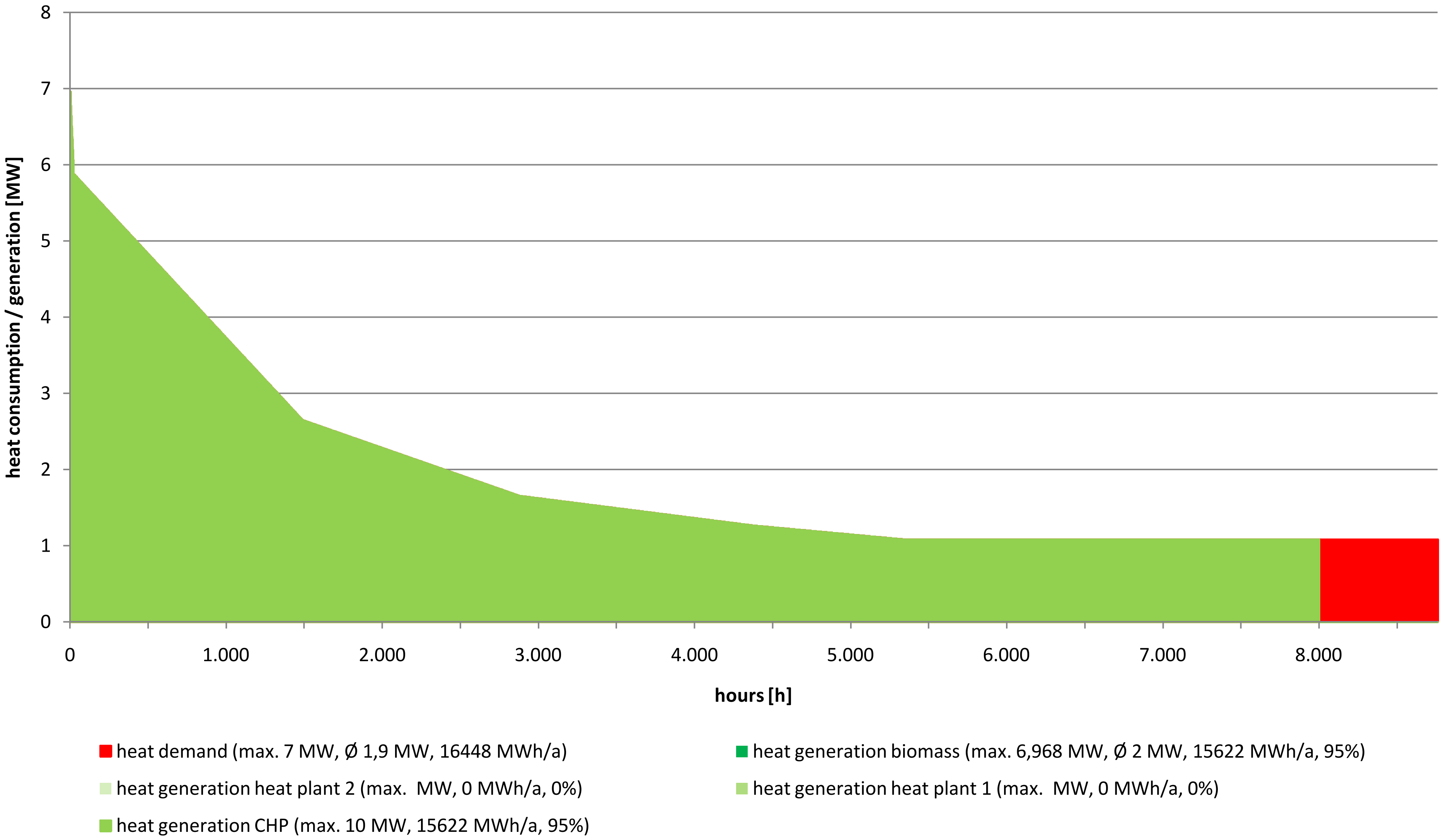

Power generation of the planned biomass CHP plant
in alternative 1 in initial stage
0,8
0,7
0,6
0,5
0,4
0,3
0,2
0,1
0,0
power generation [MW]
0
1.000
2.000
3.000
4.000
5.000
6.000
7.000
8.000
hours [h]
total power generation (max. 0,7 MW, Ø 0,7 MW, 5600 MWh/a, 100%)
power generation thru waste heat cooling (max. 0,7 MW, Ø 0,3 MW, 2460 MWh/a, 44%)
power generation thru cogeneration (max. 0,7 MW, Ø 0,4 MW, 3140 MWh/a, 56%)

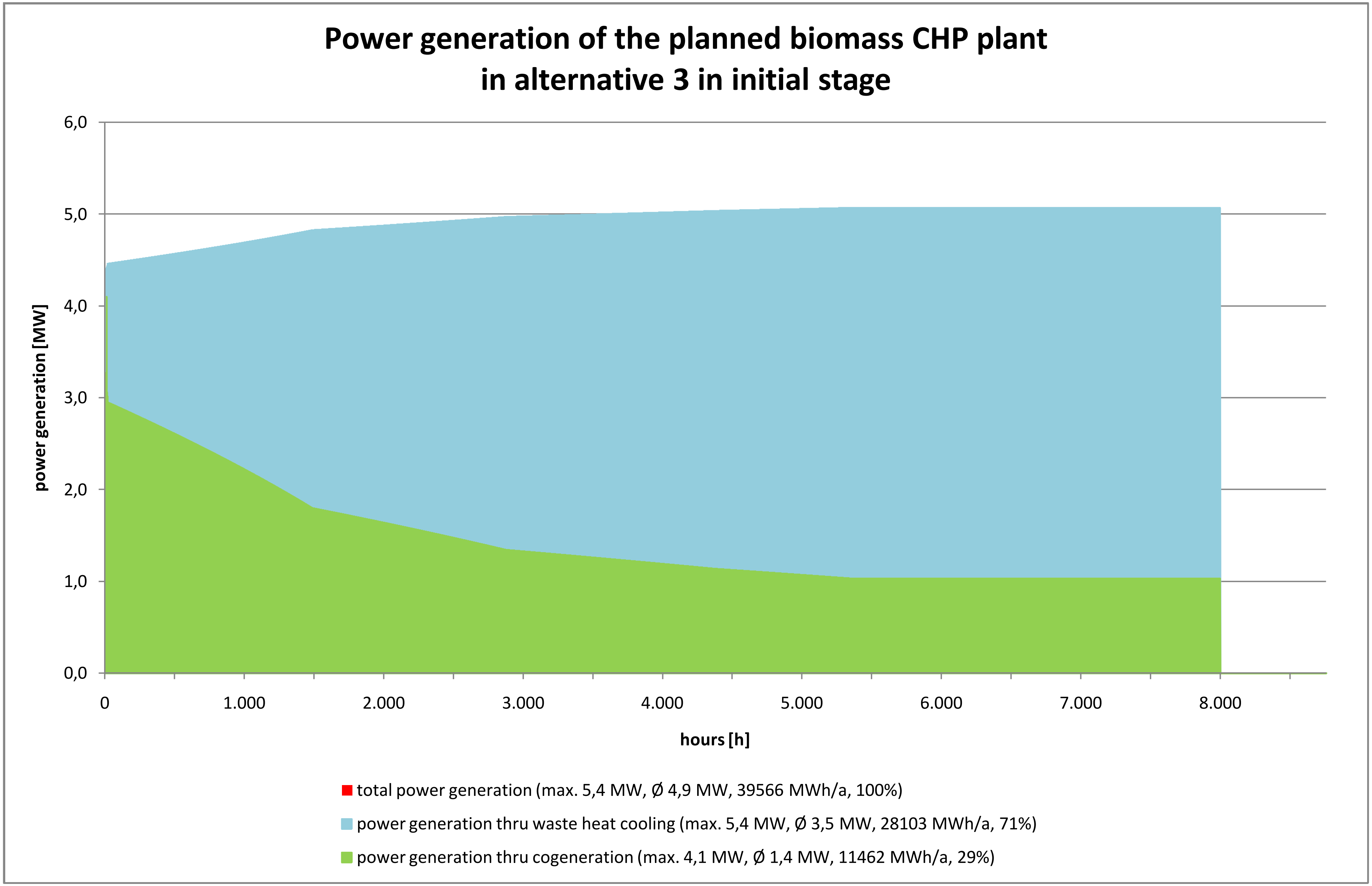

Contribution of the planned biomass CHP plant to the heat supply
in alternative 2 in initial stage
heat consumption / generation [MW]
0
1
2
3
4
5
6
7
8
0
1.000
2.000
3.000
4.000
5.000
6.000
7.000
8.000
hours [h]
heat demand (max. 7 MW, Ø 1,9 MW, 16448 MWh/a)
heat generation biomass (max. 6,968 MW, Ø 2 MW, 15622 MWh/a, 95%)
heat generation heat plant 2 (max. MW, 0 MWh/a, 0%)
heat generation heat plant 1 (max. MW, 0 MWh/a, 0%)
heat generation CHP (max. 8 MW, 15622 MWh/a, 95%)

Power generation of the planned biomass CHP plant in alternative 2 in initial stage



Contribution of the planned biomass CHP plant to the heat supply in alternative 3 in initial stage




Power generation of the planned biomass CHP plant
in alternative 3 in initial stage
6,0
5,0
4,0
3,0
2,0
1,0
0,0
power generation [MW]
0
1.000
2.000
3.000
4.000
5.000
6.000
7.000
8.000
hours [h]
total power generation (max. 5,4 MW, Ø 4,9 MW, 39566 MWh/a, 100%)
power generation thru waste heat cooling (max. 5,4 MW, Ø 3,5 MW, 28103 MWh/a, 71%)
power generation thru cogeneration (max. 4,1 MW, Ø 1,4 MW, 11462 MWh/a, 29%)

Annex IV.A.3-B

Technical Data

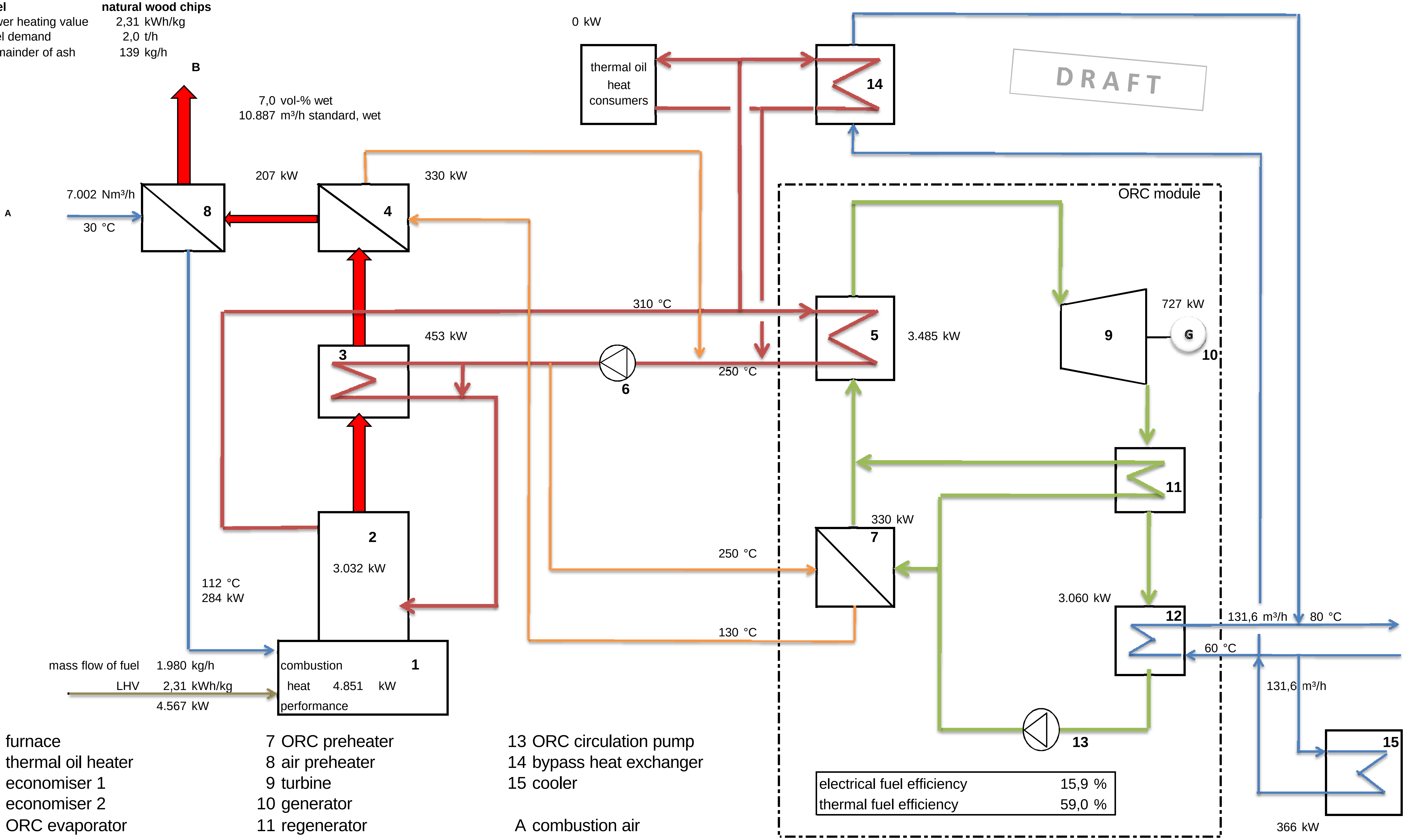
Flow sheet ORC process

Biomass CHP plant
with thermal oil boiler and ORC module

fuel	**natural wood chips**
lower heating value	2,31 kWh/kg
fuel demand	2,0 t/h
remainder of ash	139 kg/h

1260_LI_Smethport

Alternative 1
Load point 1: dimensioning



1 furnace
2 thermal oil heater
3 economiser 1
4 economiser 2
5 ORC evaporator
6 thermal oil pump

7 ORC preheater
8 air preheater
9 turbine
10 generator
11 regenerator
12 condenser

13 ORC circulation pump
14 bypass heat exchanger
15 cooler

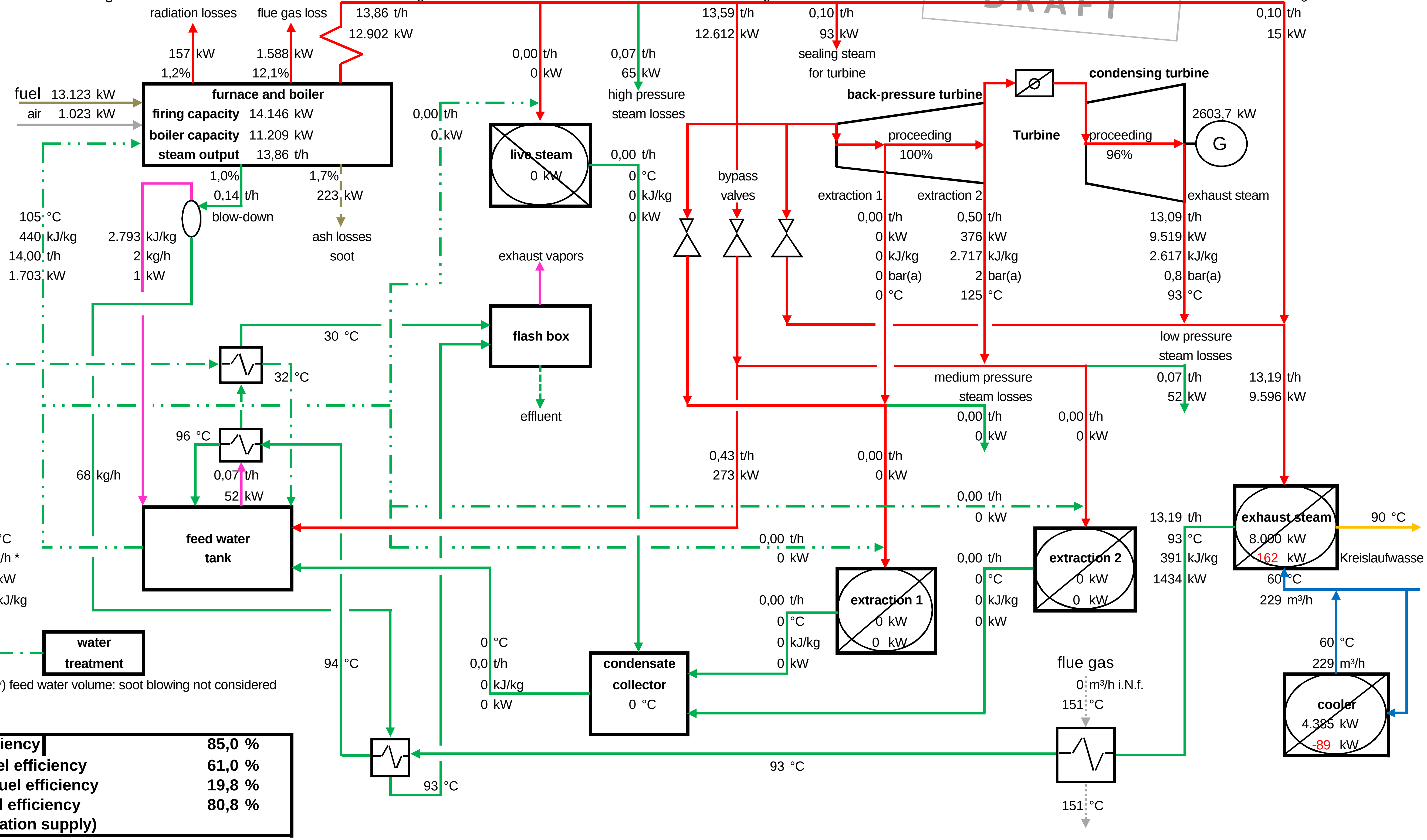
A combustion air
B flue gas

Biomass CHP plant
with steam boiler and turbine

1260_LI_Smethport

Alternative 2
Load point 1: dimensioning

fuel	**natural wood chips**
lower heat value	2,31 kWh/kg
fuel demand	5,7 t/h
remainder of ash	398 kg/h



boiler efficiency	85,0 %
thermal fuel efficiency	61,0 %
electrical fuel efficiency	19,8 %
overall fuel efficiency	80,8 %
(without station supply)	

Flow sheet water-steam process

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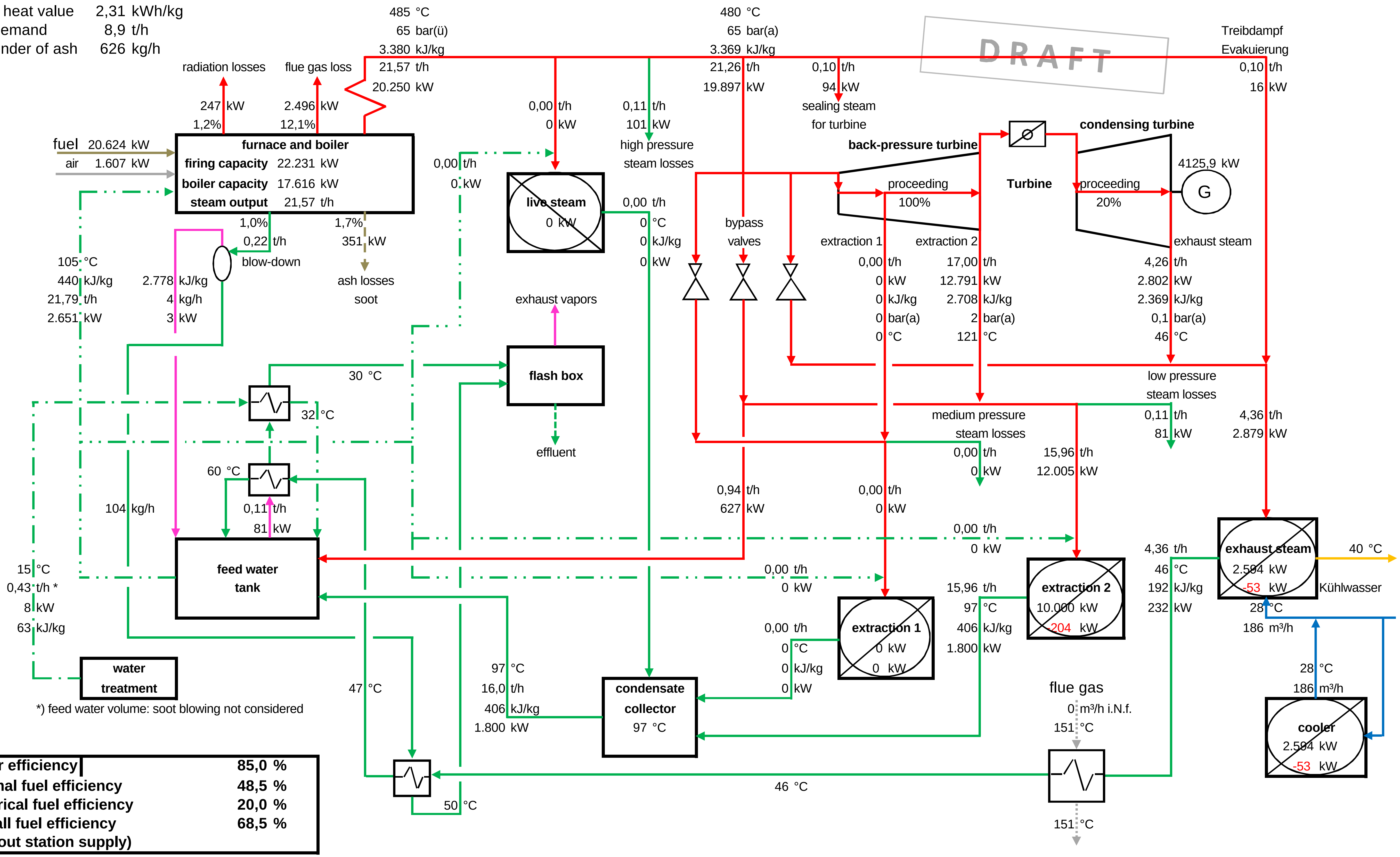
Biomass CHP plant with steam boiler and turbine

1260_LI_Smethport

Alternative 3
Load point 1: dimensioning

fuel	**natural wood chips**
lower heat value	2,31 kWh/kg
fuel demand	8,9 t/h
remainder of ash	626 kg/h



*) feed water volume: soot blowing not considered

boiler efficiency	**85,0 %**
thermal fuel efficiency	**48,5 %**
electrical fuel efficiency	**20,0 %**
overall fuel efficiency (without station supply)	**68,5 %**

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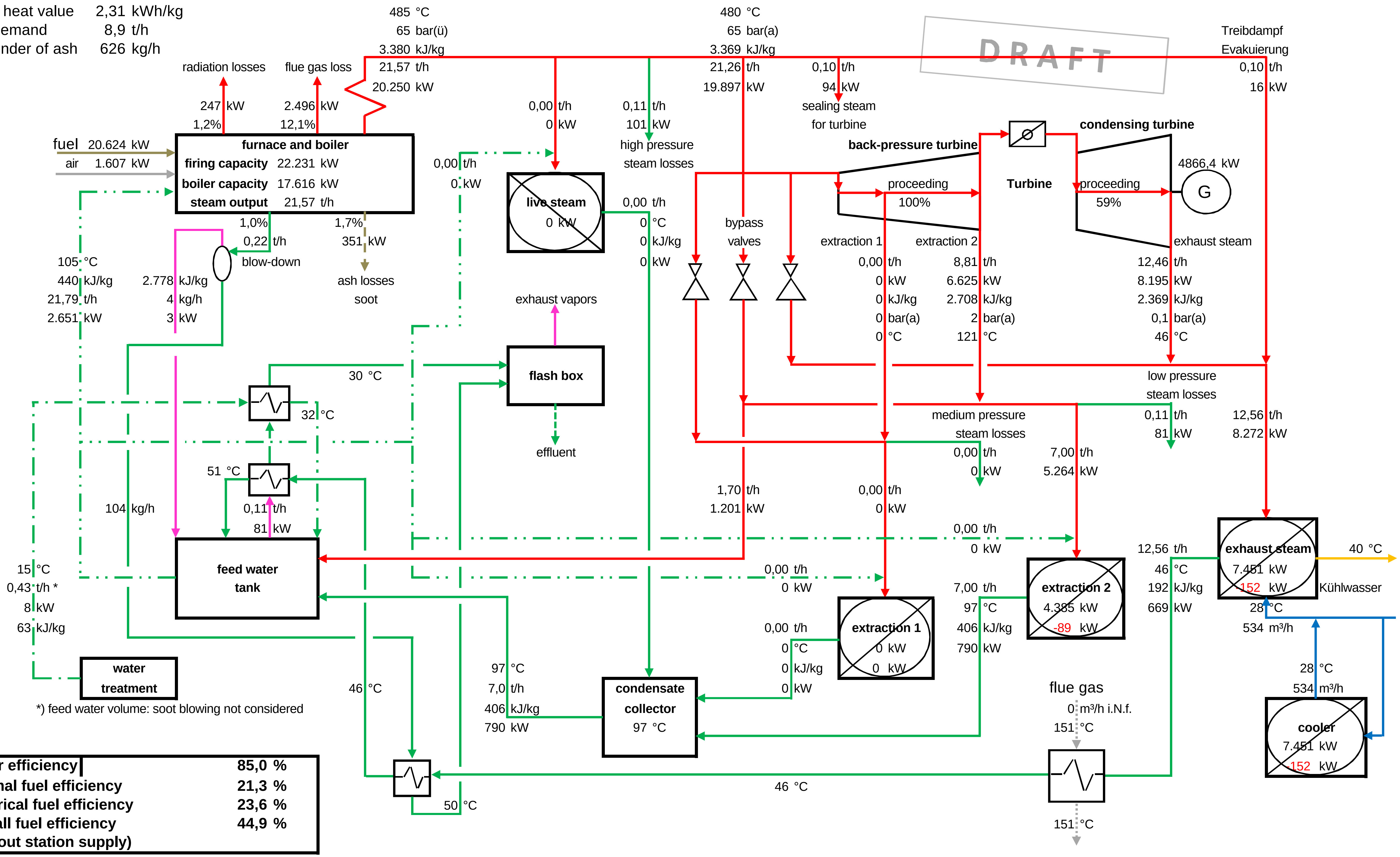
Flow sheet water-steam process

Biomass CHP plant
with steam boiler and turbine

1260_LI_Smethport

Alternative 3
Load point 2: average

fuel	**natural wood chips**
lower heat value	2,31 kWh/kg
fuel demand	8,9 t/h
remainder of ash	626 kg/h



boiler efficiency	**85,0 %**
thermal fuel efficiency	**21,3 %**
electrical fuel efficiency	**23,6 %**
overall fuel efficiency	**44,9 %**
(without station supply)	

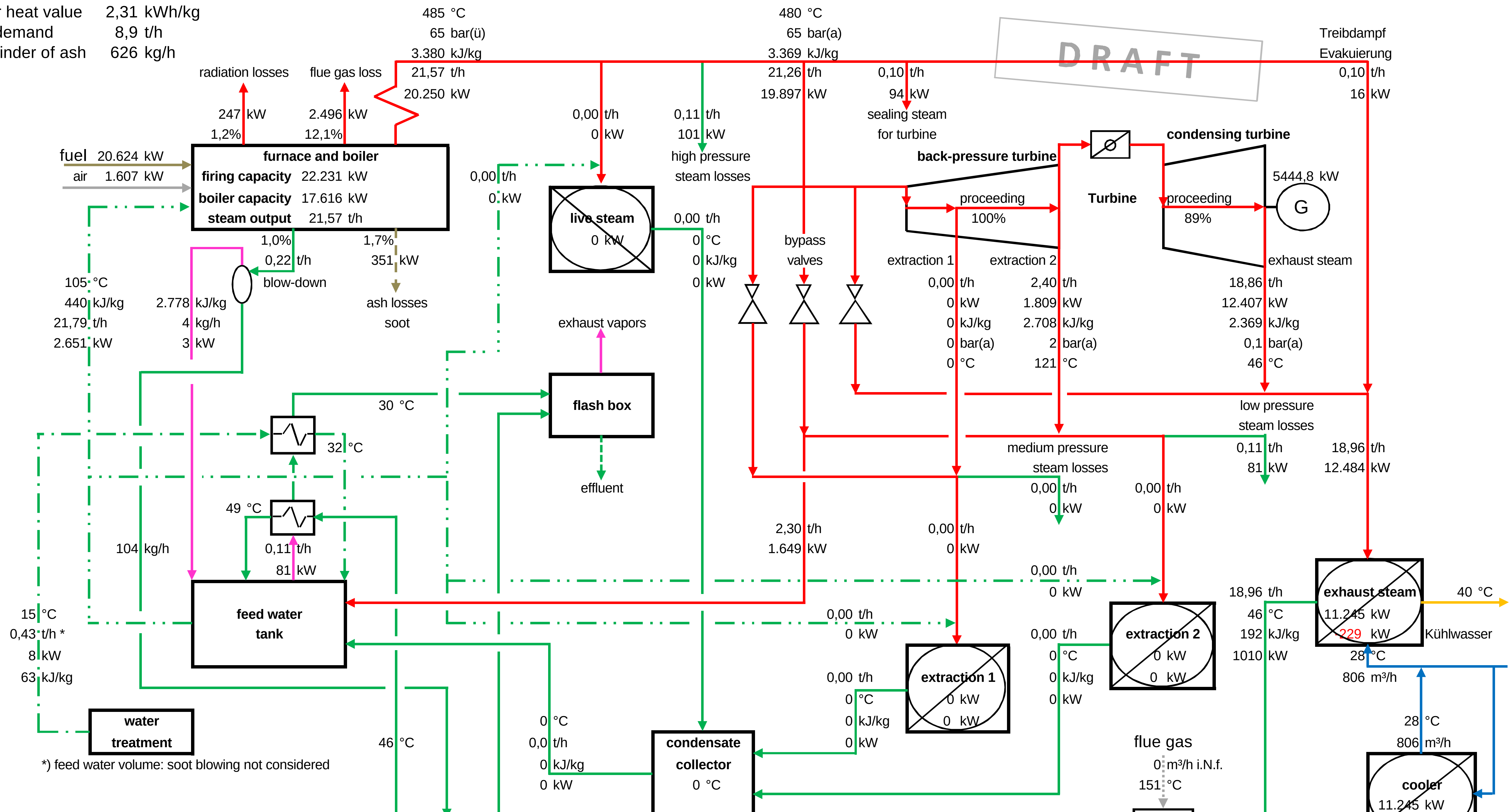
Flow sheet water-steam process

Biomass CHP plant with steam boiler and turbine

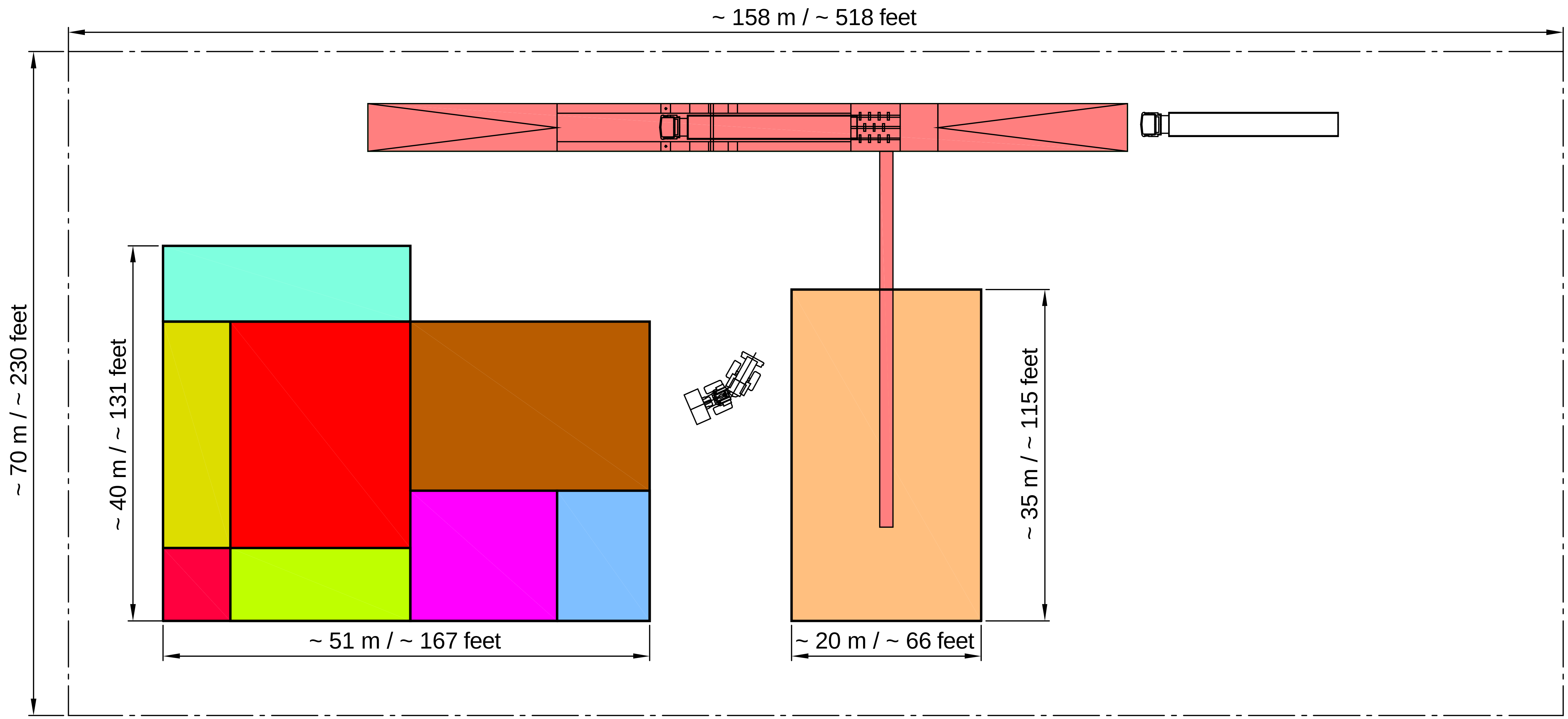
1260_LI_Smethport

Alternative 3
Load point 3: maximum

fuel	**natural wood chips**
lower heat value	2,31 kWh/kg
fuel demand	8,9 t/h
remainder of ash	626 kg/h



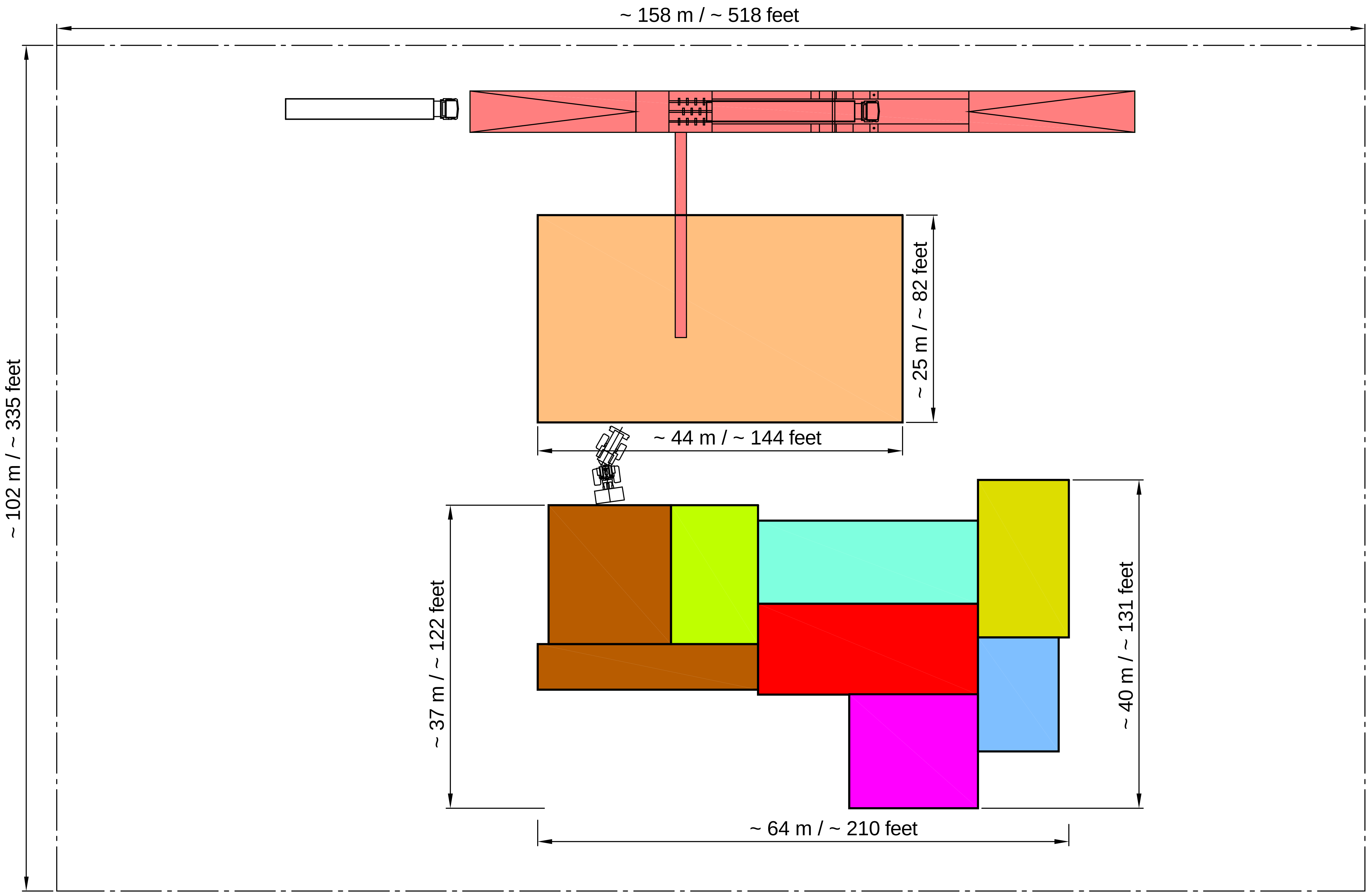
boiler efficiency	**85,0 %**
thermal fuel efficiency	**0,0 %**
electrical fuel efficiency	**26,4 %**
overall fuel efficiency	**26,4 %**
(without station supply)	



Legende / legend

- LKW-Entladung / truck dumper
- Brennstofflagerfläche Brennstofflager / fuel storage area
- Schubbodenanlage / push floor conveyor
- ORC-Anlage / ORC-Module
- Nebengebäude / outbuilding
- Kesselhaus / boiler house
- Rauchgasentstaubung und Ascheentsorgung / particulate collection and ash removal
- MS-Anlage+Trafo / medium voltage facilities + transformer
- Wärmeverteilung / heat distribution
- Gaskessel / gas-fired boiler

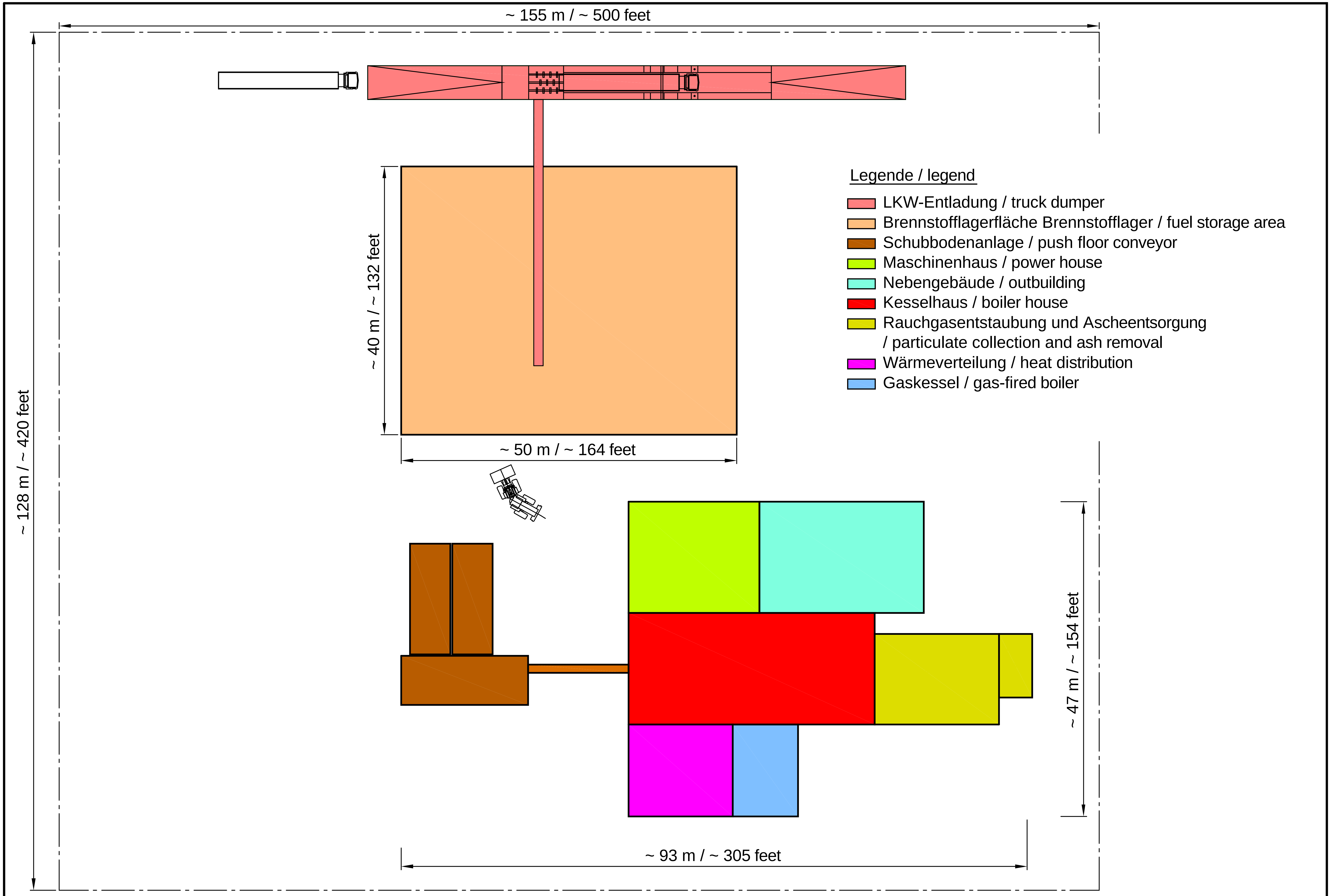
Hinweis:	Planverfasser:	Maßstab:		Benennung:	Kunde:	
Alle Maße und techn. Angaben sind verantwortlich durch den Auftragnehmer zu prüfen. Es gilt der Schutzvermerk nach DIN 34.	SEEGER ENGINEERING ENERGIE- UND UMWELTTECHNIK Industriestraße 25 - 27 37235 Hessisch Lichtenau Telefon: 05602 - 9379-0 Fax: 05602 - 2889 E-Mail: info@seeger.ag	1:500		Layout Alternative 1 Smethport (PA), USA	Lahmeyer International	
		Gezeichnet: Prinz	Datum: 04.11.2009		Stand: 04.11.2009	Zeichnungs-Nr.: 1260-01-P



Legende / legend

- LKW-Entladung / truck dumper
- Brennstofflagerfläche Brennstofflager / fuel storage area
- Schubbodenanlage / push floor conveyor
- Maschinenhaus / power house
- Nebengebäude / outbuilding
- Kesselhaus / boiler house
- Rauchgasentstaubung und Ascheentsorgung / particulate collection and ash removal
- Wärmeverteilung / heat distribution
- Gaskessel / gas-fired boiler

Hinweis: Alle Maße und techn. Angaben sind verantwortlich durch den Auftragnehmer zu prüfen. Es gilt der Schutzvermerk nach DIN 34.	Planverfasser: SEEGER ENGINEERING – ENERGIE- UND UMWELTTECHNIK, Industriestraße 25 - 27, 37235 Hessisch Lichtenau, Telefon: 05602 - 9379-0, Fax: 05602 - 2889, E-Mail: info@seeger.ag	Maßstab: 1:500 Gezeichnet: Prinz Datum: 04.11.2009	Benennung: Layout Alternative 2 Smethport (PA), USA	Kunde: Lahmeyer International Stand: 04.11.2009 Zeichnungs-Nr.: 1260-02-P



Hinweis:	Planverfasser:	Maßstab:		Benennung:	Kunde:	
Alle Maße und techn. Angaben sind verantwortlich durch den Auftragnehmer zu prüfen. Es gilt der Schutzvermerk nach DIN 34.	SEEGER ENGINEERING, ENERGIE- UND UMWELTTECHNIK, Industriestraße 25 - 27, 37235 Hessisch Lichtenau, Telefon: 05602 - 9379-0, Fax: 05602 - 2889, E-Mail: info@seeger.ag	1:500		Layout Alternative 3 Smethport (PA), USA	Lahmeyer International	
		Gezeichnet: Prinz	Datum: 04.11.2009		Stand: 04.11.2009	Zeichnungs-Nr.: 1260-03-P

Annex IV.A.3-C

Financial Data

biomass combined heat and power plant

profitability assessment

project: 1260_LI_Smethport

investment and financing plan

status quo: 27. November 2009

alternative 1: thermal oil boiler with ORC module

load point 1: dimensioning

project manag Carsten Besser
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1. investment cost estimate biomass heat and power pla

HKW (Thermoölkessel mit ORC-Prozess) 4,9 MW FWL

1.1 technology		€ net
a)	separator for impurities (overlengths, ferrous m	0
b)	fuel storage and transport	300.000
c)	furnace and boiler	2.300.000
d)	flue gas cleaning (electrostatic precipitator)	250.000
e)	emission measurement	100.000
f)	flue gas discharge	50.000
g)	water treatment	0
h)	power generation	1.430.000
i)	vacuum condenser	0
j)	heat exchanger / cooler	250.000
k)	piping and heat distribution	400.000
l)	switchgear, transformer, cabeling	200.000
m)	process control enginnering	150.000
n)	compressed air generation	35.000
o)	crane (turbine house)	30.000
p)	fire extinguishing installation	50.000
q)	building services	150.000
r)	wheel loader	160.000
s)	biomass hot water boiler	900.000
t)	gas-fired peak load boiler	250.000
u)	truck weigh station	35.000
v)	emergency power supply	40.000
w)	heat grid	0
x)	transfer station	0
y)	truck dumper	700.000
z)		0
	total technology	**7.780.000**

unconsidered options

separator for impurities (overlengths, ferrous m	200.000
silo for ashes	200.000
SNCR nitrogen oxide reduction facility	175.000

* all information based on current estimated prices

1.2 real estate		€ net
a)	real estate costs	0
b)	development costs	0
	total real estate	**0**

1.3 construction		€ net
a)	buildings	1.500.000
b)	outside facilities	300.000
c)	civil engineering	100.000
	total construction	**1.900.000**

1.4 engineering services		€ net
a)	architect and engineering services	580.000
b)	permission and surveys	0
c)	additional construction costs	0
d)	start-up costs of project	0
	total engineering services	**580.000**

		€ net
subtotal		**10.260.000**
miscellaneous	**2,5%**	**256.500**
overall investment		**10.516.500**

2. financing plan

2.1 subsidies		€ net
a)	overall investment	10.516.500
b)	eligible investment volume	7.333.333
c)	quota of eligible investment	50,0%
	total subsidies	**3.666.667**

2.2 additional charges		€ net
a)	financing costs (0,5%)	24.934
b)	interest during investment period (5,0%)	249.344
c)	miscellaneous	
	total additional charges	**274.278**

2.3 financing			€ net
a)	investment volume to be financed		7.124.112
b)	equity capital	30%	2.137.233
c)	loan capital	70%	4.986.878
	overall investment minus subsidies		**7.124.112**

	€ net
overall investment incl. additonal charges	**10.790.778**
subsidies	**3.666.667**
total amount to be financed	**7.124.112**
equity capital	**2.137.233**
loan capital	**4.986.878**

biomass combined heat and power plant
profitability assessment
project: 1260_LI_Smethport
amortization schedule (T€)
status quo: 27. November 2009

alternative 1: thermal oil boiler with ORC module
load point 1: dimensioning

project manager: Carsten Besser
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I. time schedule		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
1. quarter	status quo of investment	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2. quarter	status quo of investment	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
3. quarter	status quo of investment	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
4. quarter	status quo of investment	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
investments per year		**0%**	**100%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**
status quo of investment at end of year		**0%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

II. amortization calculation

loan capital	**4.987**	**T€**
interest	6,00%	
payout	100%	
life of loan	15	years
number of installme	4	times/year
annuity	127	T€/quarter
	10,30	%

		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
1. quarter	status quo of loan	0	0	4.829	4.607	4.372	4.122	3.857	3.576	3.277	2.960	2.624	2.267	1.888	1.486	1.059	606	125
	interest	0	0	72	69	66	62	58	54	49	44	39	34	28	22	16	9	2
	amortization	0	0	54	58	61	65	69	73	77	82	87	93	98	104	111	118	125
	annuity	0	0	127	127	127	127	127	127	127	127	127	127	127	127	127	127	127
2. quarter	status quo of loan	0	4.987	4.775	4.550	4.311	4.057	3.788	3.503	3.200	2.878	2.537	2.174	1.789	1.381	948	488	0
	interest	0	75	72	68	65	61	57	53	48	43	38	33	27	21	14	7	0
	amortization	0	52	55	58	62	66	70	74	79	83	89	94	100	106	112	119	0
	annuity	0	127	127	127	127	127	127	127	127	127	127	127	127	127	127	127	0
3. quarter	status quo of loan	0	4.935	4.720	4.491	4.249	3.992	3.719	3.429	3.121	2.795	2.448	2.080	1.690	1.275	836	369	0
	interest	0	74	71	67	64	60	56	51	47	42	37	31	25	19	13	6	0
	amortization	0	53	56	59	63	67	71	75	80	85	90	95	101	108	114	121	0
	annuity	0	127	127	127	127	127	127	127	127	127	127	127	127	127	127	127	0
4. quarter	status quo of loan	0	4.882	4.664	4.432	4.186	3.925	3.648	3.353	3.041	2.710	2.358	1.985	1.588	1.168	721	248	0
	interest	0	73	70	66	63	59	55	50	46	41	35	30	24	18	11	4	0
	amortization	0	53	57	60	64	68	72	76	81	86	91	97	103	109	116	123	0
	annuity	0	127	127	127	127	127	127	127	127	127	127	127	127	127	127	127	0
status quo of loan at end of year		**0**	**4.829**	**4.607**	**4.372**	**4.122**	**3.857**	**3.576**	**3.277**	**2.960**	**2.624**	**2.267**	**1.888**	**1.486**	**1.059**	**606**	**125**	**0**
	interest per year	0	222	285	271	257	241	225	208	190	170	149	128	104	80	53	26	2
	amortization per year	0	158	222	235	250	265	281	299	317	336	357	379	402	427	453	481	125
	annuity per year	0	380	507	507	507	507	507	507	507	507	507	507	507	507	507	507	127

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I. interest on partner's loan (equity capital)

1. composition of loan (equity capital)	absolut	in percent
a.) partner A	**2.137 T€**	100,0 %
b.) partner B	0 **T€**	0,0 %
c.) partner C	0 **T€**	0,0 %
loan	**2.137** T€	100,0 %

interest rate	10,00 %
life of loan	15 Jahre

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
2. interest on partner's loan [€/a]	0	160	214	214	214	214	214	214	214	214	214	214	214	214	214	214	53

II depreciation

1. depreciation parameters

a.) depreciation type	linear
b.) recovery period	15 years
c.) depreciable amount	10.791 T€

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
2. annual depreciation [€/a]	0	540	719	719	719	719	719	719	719	719	719	719	719	719	719	719	180

biomass combined heat and power plant

profitability assessment

project: 1260_LI_Smethport

revenues (T€)

status 27. November 2009

alternative 1: thermal oil boiler with ORC module

load point 1: dimensioning

begin of operatioı 01.07.2011

project manager Carsten Besser

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					2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
I. general conditions				workload	0%	75%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	25%
operating hours																					
biomass CHP plant	h/a	8.000			0	6.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	2.000
power generation	h/a	8.000			0	6.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	2.000
heat generation	h/a	8.760			0	6.570	8.760	8.760	8.760	8.760	8.760	8.760	8.760	8.760	8.760	8.760	8.760	8.760	8.760	8.760	2.190
redundancy boiler	h/a	760			0	570	760	760	760	760	760	760	760	760	760	760	760	760	760	760	190
II. revenues				price inflation																	
1. power feed-in																					
average capacity	MW	0,727			0,000	0,727	0,727	0,727	0,727	0,727	0,727	0,727	0,727	0,727	0,727	0,727	0,727	0,727	0,727	0,727	0,727
annual power generation	MWh/a	5.816			0	4.362	5.816	5.816	5.816	5.816	5.816	5.816	5.816	5.816	5.816	5.816	5.816	5.816	5.816	5.816	1.454
power feed-in tariff	€/MWh	86,67		0,0%	0,00	86,67	86,67	86,67	86,67	86,67	86,67	86,67	86,67	86,67	86,67	86,67	86,67	86,67	86,67	86,67	86,67
revenues from power feed-i	T€/a		**504**		**0**	**378**	**504**	**504**	**504**	**504**	**504**	**504**	**504**	**504**	**504**	**504**	**504**	**504**	**504**	**504**	**126**
2. heat sale																					
average capacity	MW	3,74		0,0%	0,00	3,74	3,74	3,74	3,74	3,74	3,74	3,74	3,74	3,74	3,74	3,74	3,74	3,74	3,74	3,74	3,74
annual heat supply	MWh/a	32.725			0	24.544	32.725	32.725	32.725	32.725	32.725	32.725	32.725	32.725	32.725	32.725	32.725	32.725	32.725	32.725	8.181
heat price	€/MWh	41,15		0,0%	0,00	41,15	41,15	41,15	41,15	41,15	41,15	41,15	41,15	41,15	41,15	41,15	41,15	41,15	41,15	41,15	41,15
revenues from heat sale	T€/a		**1.347**		**0**	**1.010**	**1.347**	**1.347**	**1.347**	**1.347**	**1.347**	**1.347**	**1.347**	**1.347**	**1.347**	**1.347**	**1.347**	**1.347**	**1.347**	**1.347**	**337**
3. fuel saving (fuel oil etc.)																					
annual fuel saving	Tl/a	3.943			0	2.957	3.943	3.943	3.943	3.943	3.943	3.943	3.943	3.943	3.943	3.943	3.943	3.943	3.943	3.943	986
fuel price	€/l			0,0%	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
revenues from fuel saving	T€/a		**0**		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
4. sale of green certificates																					
certificates per year	pieces	0			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
price per certificate	€/piece	0		0,0%	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
revenues from sale of greer	T€/a		**0**		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
III. total revenues	**T€/a**		**1.851**		**0**	**1.388**	**1.851**	**1.851**	**1.851**	**1.851**	**1.851**	**1.851**	**1.851**	**1.851**	**1.851**	**1.851**	**1.851**	**1.851**	**1.851**	**1.851**	**463**

biomass combined heat and power plant

profitability assessment

project: 1260_LI_Smethport

alternative 1: thermal oil boiler with ORC module

operating costs (T€)

load point 1: dimensioning

status 27. November 2009

begin of operation 01.07.2011

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					2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
I. general conditions				workload	0%	75%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	25%
design data																					
operating hours CHP	h/a	8.000			0	6.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	2.000
average fuel power input	MW	6,2		0,0%	0,0	6,2	6,2	6,2	6,2	6,2	6,2	6,2	6,2	6,2	6,2	6,2	6,2	6,2	6,2	6,2	6,2
annual fuel energy	MWh/a	49.600			0	37.200	49.600	49.600	49.600	49.600	49.600	49.600	49.600	49.600	49.600	49.600	49.600	49.600	49.600	49.600	12.400
redundancy boiler	h/a	760			0	570	760	760	760	760	760	760	760	760	760	760	760	760	760	760	190
II. usage-bound costs				price inflation																	
1. fuel supply																					
average calorific value of fuel	MWh/t	2,3																			
required amount of fuel	t/a	21.565			0	16.174	21.565	21.565	21.565	21.565	21.565	21.565	21.565	21.565	21.565	21.565	21.565	21.565	21.565	21.565	5.391
specific fuel costs	€/t	23,33		0,0%	0,00	23,33	23,33	23,33	23,33	23,33	23,33	23,33	23,33	23,33	23,33	23,33	23,33	23,33	23,33	23,33	23,33
costs of fuel supply	T€/a		**503**		**0**	**377**	**503**	**503**	**503**	**503**	**503**	**503**	**503**	**503**	**503**	**503**	**503**	**503**	**503**	**503**	**126**
2. power supply																					
average capacity	kW	150			0	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150
annual power requirement	MWh/a	1.200			0	900	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	300
specific electricity costs	€/MWh	53,33		0,0%	0,00	53,33	53,33	53,33	53,33	53,33	53,33	53,33	53,33	53,33	53,33	53,33	53,33	53,33	53,33	53,33	53,33
costs of power supply	T€/a		**64**		**0**	**48**	**64**	**64**	**64**	**64**	**64**	**64**	**64**	**64**	**64**	**64**	**64**	**64**	**64**	**64**	**16**
3. ash disposal																					
annual amount of ash	t/a	1.078			0	809	1.078	1.078	1.078	1.078	1.078	1.078	1.078	1.078	1.078	1.078	1.078	1.078	1.078	1.078	270
specific costs of ash disposal	€/t	13,33		0,0%	0,00	13,33	13,33	13,33	13,33	13,33	13,33	13,33	13,33	13,33	13,33	13,33	13,33	13,33	13,33	13,33	13,33
costs of ash disposal	T€/a		**14**		**0**	**11**	**14**	**14**	**14**	**14**	**14**	**14**	**14**	**14**	**14**	**14**	**14**	**14**	**14**	**14**	**4**
4. water treatment																					
water amount treated per hour	m^3/h	0,0			0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
specific costs of water treatment	€/m^3	0,00		0,0%	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
costs of water treatment	T€/a		**0**		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
5. peak load / redundancy covering																					
annual heat capacity of fuel	MWh/a	6.400			0	4.800	6.400	6.400	6.400	6.400	6.400	6.400	6.400	6.400	6.400	6.400	6.400	6.400	6.400	6.400	1.600
specific costs of heat capacity	€/MWh	26,67		0,0%	0,00	26,67	26,67	26,67	26,67	26,67	26,67	26,67	26,67	26,67	26,67	26,67	26,67	26,67	26,67	26,67	26,67
costs of peak load / redundancy coveri	T€/a		**171**		**0**	**128**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**43**
6. operating supplies	T€/a	25	**25**	0,0%	**0**	**19**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**6**
III. subtotal operating costs	T€/a		**777**		**0**	**583**	**777**	**777**	**777**	**777**	**777**	**777**	**777**	**777**	**777**	**777**	**777**	**777**	**777**	**777**	**194**

biomass combined heat and power plant

profitability assessment

project: 1260_LI_Smethport

alternative 1: thermal oil boiler with ORC module

operating costs (T€)

load point 1: dimensioning

status 27. November 2009

begin of operatior 01.07.2011

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					2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
IV. general conditions				workload	0%	75%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	25%
design data																					
operating hours CHP	h/a	8.000			0	6.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	2.000
average fuel power input	MW	6,2		0,0%	0,0	6,2	6,2	6,2	6,2	6,2	6,2	6,2	6,2	6,2	6,2	6,2	6,2	6,2	6,2	6,2	6,2
annual fuel energy	MWh/a	49.600			0	37.200	49.600	49.600	49.600	49.600	49.600	49.600	49.600	49.600	49.600	49.600	49.600	49.600	49.600	49.600	12.400
redundancy boiler	h/a	760			0	570	760	760	760	760	760	760	760	760	760	760	760	760	760	760	190
V. operating costs				price inflation																	
1. salaries and wages																					
personnel requirement	employees	4,0			0	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
labor costs	T€/a employee	40		0,0%	0	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40
operating costs	T€/a		**160**		**0**	**120**	**160**	**160**	**160**	**160**	**160**	**160**	**160**	**160**	**160**	**160**	**160**	**160**	**160**	**160**	**40**
2. service and maintenance																					
specific costs as % of investment	%	1,5		0,0%	0,0	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5
costs of service and maintenance	T€/a		**145**		**0**	**109**	**145**	**145**	**145**	**145**	**145**	**145**	**145**	**145**	**145**	**145**	**145**	**145**	**145**	**145**	**36**
3. miscellaneous																					
management	T€/a			0,0%	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
insurance	T€/a	0		0,0%	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
total miscellaneous costs	T€/a		**0**		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
VI. subtotal operating costs	T€/a		**305**		**0**	**229**	**305**	**305**	**305**	**305**	**305**	**305**	**305**	**305**	**305**	**305**	**305**	**305**	**305**	**305**	**76**
VII total operating costs	T€/a		**1.082**		**0**	**812**	**1.082**	**1.082**	**1.082**	**1.082**	**1.082**	**1.082**	**1.082**	**1.082**	**1.082**	**1.082**	**1.082**	**1.082**	**1.082**	**1.082**	**271**

biomass combined heat and power plant
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status quo 27. November 2009

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begin of operation: 01.07.2011

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			2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
I.	**revenues**																		
1.	revenues from power feed-in	T€/a	0	378	504	504	504	504	504	504	504	504	504	504	504	504	504	504	126
2.	revenues from heat sale	T€/a	0	1.010	1.347	1.347	1.347	1.347	1.347	1.347	1.347	1.347	1.347	1.347	1.347	1.347	1.347	1.347	337
3.	revenues from fuel saving	T€/a	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4.	revenues from sale of green certificates	T€/a	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	total revenues	**T€/a**	**0**	**1.388**	**1.851**	**1.851**	**1.851**	**1.851**	**1.851**	**1.851**	**1.851**	**1.851**	**1.851**	**1.851**	**1.851**	**1.851**	**1.851**	**1.851**	**463**
II.	**costs**																		
1.	costs of fuel supply	T€/a	0	377	503	503	503	503	503	503	503	503	503	503	503	503	503	503	126
2.	costs of power supply	T€/a	0	48	64	64	64	64	64	64	64	64	64	64	64	64	64	64	16
3.	costs of ash disposal	T€/a	0	11	14	14	14	14	14	14	14	14	14	14	14	14	14	14	4
4.	costs of water treatment	T€/a	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.	costs of peak load / redundancy covering	T€/a	0	128	171	171	171	171	171	171	171	171	171	171	171	171	171	171	43
6.	costs of operating supplies	T€/a	0	19	25	25	25	25	25	25	25	25	25	25	25	25	25	25	6
7.	operating costs	T€/a	0	120	160	160	160	160	160	160	160	160	160	160	160	160	160	160	40
8.	costs of service and maintenance	T€/a	0	109	145	145	145	145	145	145	145	145	145	145	145	145	145	145	36
9.	costs of management	T€/a	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10.	insurance costs	T€/a	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11.	depreciation	T€/a	0	540	719	719	719	719	719	719	719	719	719	719	719	719	719	719	180
12.	interests on loan capital	T€/a	0	222	285	271	257	241	225	208	190	170	149	128	104	80	53	26	2
13.	interests on partner's loan	T€/a	0	160	214	214	214	214	214	214	214	214	214	214	214	214	214	214	53
	overall costs	**T€/a**	**0**	**1.734**	**2.300**	**2.287**	**2.272**	**2.257**	**2.241**	**2.223**	**2.205**	**2.186**	**2.165**	**2.143**	**2.120**	**2.095**	**2.069**	**2.041**	**506**
III.	**annual result**																		
1.	total revenues	T€/a	0	1.388	1.851	1.851	1.851	1.851	1.851	1.851	1.851	1.851	1.851	1.851	1.851	1.851	1.851	1.851	463
2.	overall costs	T€/a	0	-1.734	-2.300	-2.287	-2.272	-2.257	-2.241	-2.223	-2.205	-2.186	-2.165	-2.143	-2.120	-2.095	-2.069	-2.041	-506
		T€/a	**0**	**-346**	**-450**	**-436**	**-422**	**-406**	**-390**	**-373**	**-354**	**-335**	**-314**	**-292**	**-269**	**-245**	**-218**	**-191**	**-43**

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			2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
IV.	**cash flow before debt service (loan capital)**																		
1.	annual result	T€/a	0	-346	-450	-436	-422	-406	-390	-373	-354	-335	-314	-292	-269	-245	-218	-191	-43
2.	depreciation	T€/a	0	540	719	719	719	719	719	719	719	719	719	719	719	719	719	719	180
3.	interests on loan capital	T€/a	0	222	285	271	257	241	225	208	190	170	149	128	104	80	53	26	2
4.	interests on partner's loan	T€/a	0	160	214	214	214	214	214	214	214	214	214	214	214	214	214	214	53
	cash flow before debt service (loan capital)	**T€/a**	**0**	**576**	**768**	**768**	**768**	**768**	**768**	**768**	**768**	**768**	**768**	**768**	**768**	**768**	**768**	**768**	**192**
V.	**debt service (loan capital)**																		
1.	interests	T€/a	0	222	285	271	257	241	225	208	190	170	149	128	104	80	53	26	2
2.	amortization	T€/a	0	158	222	235	250	265	281	299	317	336	357	379	402	427	453	481	125
	annual debt service	**T€/a**	**0**	**380**	**507**	**507**	**507**	**507**	**507**	**507**	**507**	**507**	**507**	**507**	**507**	**507**	**507**	**507**	**127**
	status quo of loan at end of year	**T€**	**0**	**4.829**	**4.607**	**4.372**	**4.122**	**3.857**	**3.576**	**3.277**	**2.960**	**2.624**	**2.267**	**1.888**	**1.486**	**1.059**	**606**	**125**	**0**
VI.	**cash flow after debt service (loan capital)**																		
1.	cash flow before debt service (loan capital)	T€/a	0	576	768	768	768	768	768	768	768	768	768	768	768	768	768	768	192
2.	debt service (loan capital)	T€/a	0	-380	-507	-507	-507	-507	-507	-507	-507	-507	-507	-507	-507	-507	-507	-507	-127
	cash flow after debt service (loan capital)	**T€/a**	**0**	**196**	**262**	**262**	**262**	**262**	**262**	**262**	**262**	**262**	**262**	**262**	**262**	**262**	**262**	**262**	**65**
VII.	**cash flow after debt service and interest on partner's loan**																		
1.	cash flow after debt service (loan capital)	T€/a	0	196	262	262	262	262	262	262	262	262	262	262	262	262	262	262	65
2.	interest on partner's loan	T€/a	0	-160	-214	-214	-214	-214	-214	-214	-214	-214	-214	-214	-214	-214	-214	-214	-53
	cash flow after debt service and interest on	**T€/a**	**0**	**36**	**48**	**48**	**48**	**48**	**48**	**48**	**48**	**48**	**48**	**48**	**48**	**48**	**48**	**48**	**12**
VIII.	**growths in equity**																		
1.	investments per year	T€/a	0	-2.137	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.	cash flow after debt service (loan capital)	T€/a	0	196	262	262	262	262	262	262	262	262	262	262	262	262	262	262	65
	growths in equity	**T€/a**	**0**	**-1.941**	**262**	**262**	**262**	**262**	**262**	**262**	**262**	**262**	**262**	**262**	**262**	**262**	**262**	**262**	**65**
	growths in equity accumulated	**T€**	**0**	**-1.941**	**-1.679**	**-1.418**	**-1.156**	**-894**	**-632**	**-371**	**-109**	**153**	**415**	**676**	**938**	**1.200**	**1.461**	**1.723**	**1.789**
IX.	**internal rate of return**																		
1.	growths in equity	T€/a	0	-1.941	262	262	262	262	262	262	262	262	262	262	262	262	262	262	65
	internal rate of return		**10,0%**																
	(from cash flow + interest on equity capital)																		

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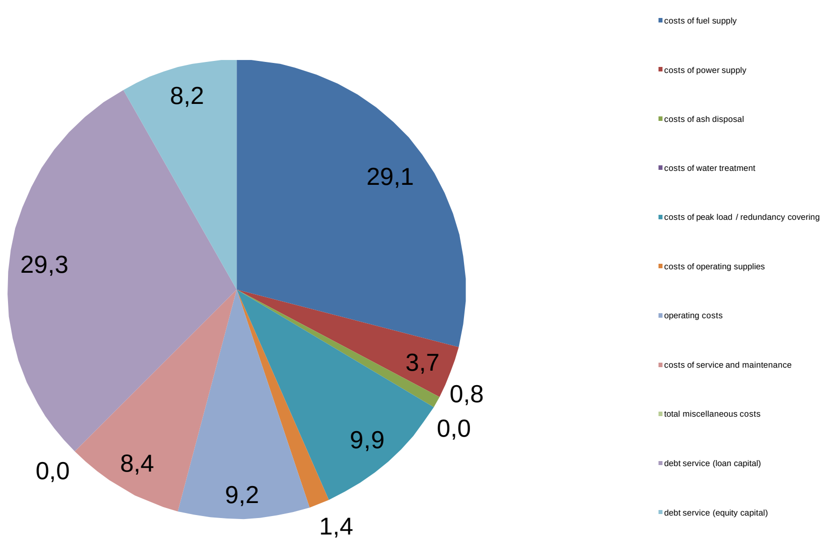
A. marginal costing

a) heat output	32.725 MWh/a		

specific costs of heat generation	[T€/a]	[€/MWh]	[%]
a) costs of fuel supply	503	15,38	29,1
b) costs of power supply	64	1,96	3,7
c) costs of ash disposal	14	0,44	0,8
d) costs of water treatment	0	0,00	0,0
e) costs of peak load / redundancy covering	171	5,22	9,9
f) costs of operating supplies	25	0,76	1,4
g) operating costs	160	4,89	9,2
h) costs of service and maintenance	145	4,44	8,4
i) total miscellaneous costs	0	0,00	0,0
total operating costs	**1.082**	**33,08**	**62,5**
j) debt service (loan capital)	507	15,48	29,3
k) debt service (equity capital)	142	4,35	8,2
costs of capital	**649**	**19,83**	**37,5**
marginal costing of heat generation	**1.731**	**52,91**	**100**
(without power feed-in)			
k) revenues from power feed-in	504	15,40	29
k) revenues from fuel saving	0	0,00	0
l) revenues from sale of green certificates	0	0,00	0
marginal costing of heat generation	**1.227**	**37,51**	**71**
(with power feed-in)			

Wesentliche spezifische Kosten der Wärmegestehung in %

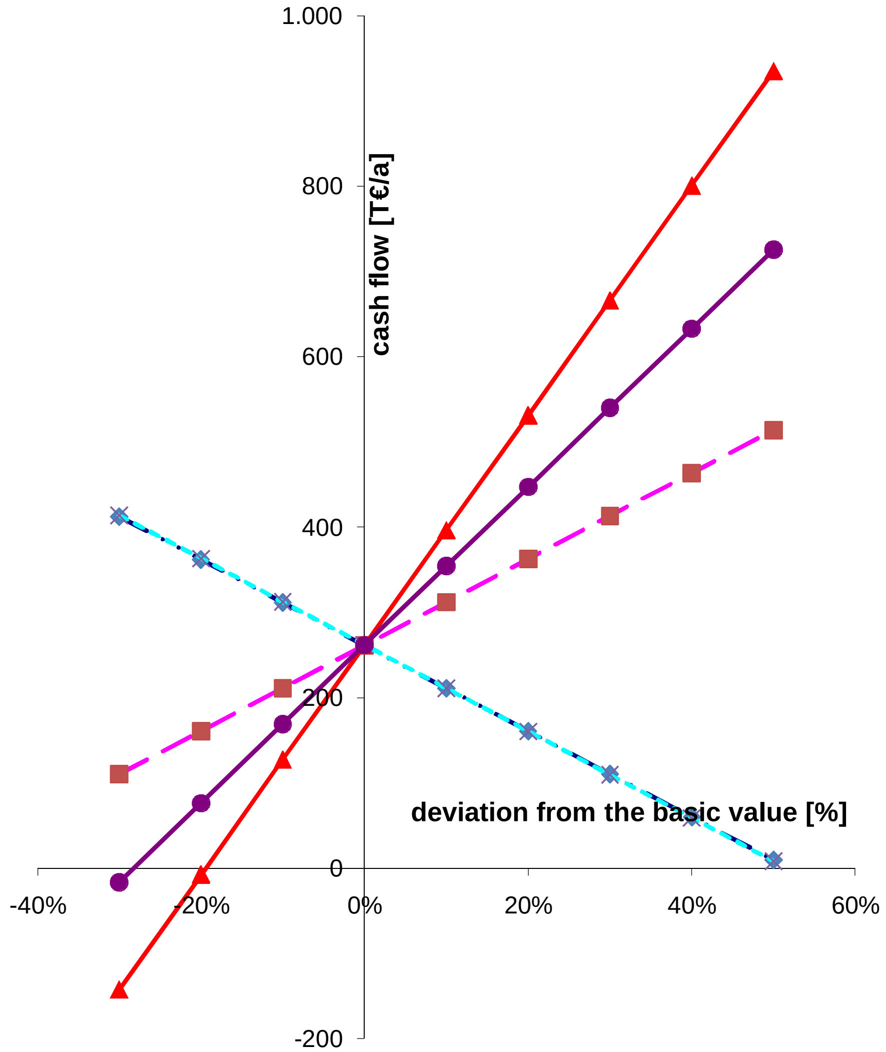


B. sensitivity analysis

cash flow after debt service (loan capi **262 T€/a** (basic value)

output parameter	unit	value ∅	productivity in full load hours -30%	-20%	-10%	0%	10%	20%	30%	40%	50%
conditions of fuel purchase	€/MWh	23,33	413	362	312	262	211	161	111	60	10
power production	TMWh/a	6	111	161	211	262	312	363	413	463	514
specific sales terms of heat	€/MWh	41,15	-142	-8	127	262	396	531	666	800	935
costs of capital	€/a	507	414	363	312	262	211	160	110	59	8
productivity in full load hours	h/a	8.000	-17	76	169	262	355	447	540	633	726

Sensitivity of the cash flow to the deviation of single parameters



The steeper the gradient of one single parameter, no matter if positive or negative, the more sensitive is the considered parameter to a deviation from the basic value.

biomass combined heat and power plant
profitability assessment
project: 1260_LI_Smethport
investment and financing plan
status quo: 27. November 2009

alternative 2: steam boiler with heating type turbine
load point 1: dimensioning

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1. investment cost estimate biomass heat and power pla

HKW (Dampf-Kraft-Prozess)		14,0 MW FWL
1.1 technology		**€ net**
a)	separator for impurities (overlengths, ferrous m	0
b)	fuel storage and transport	500.000
c)	furnace and boiler	4.250.000
d)	flue gas cleaning (electrostatic precipitator)	475.000
e)	emission measurement	100.000
f)	flue gas discharge	55.000
g)	water treatment	100.000
h)	power generation	2.250.000
i)	vacuum condenser	350.000
j)	heat exchanger / cooler	350.000
k)	piping and heat distribution	600.000
l)	switchgear, transformer, cabeling	600.000
m)	process control enginnering	150.000
n)	compressed air generation	35.000
o)	crane (turbine house)	30.000
p)	fire extinguishing installation	50.000
q)	building services	150.000
r)	wheel loader	160.000
s)	biomass hot water boiler	0
t)	gas-fired peak load boiler	250.000
u)	truck weigh station	35.000
v)	emergency power supply	40.000
w)	heat grid	0
x)	transfer station	0
y)	truck dumper	700.000
z)		0
	total technology	**11.230.000**

unconsidered options

separator for impurities (overlengths, ferrous m	250.000
silo for ashes	250.000
SNCR nitrogen oxide reduction facility	225.000

* all information based on current estimated prices

1.2 real estate		**€ net**
a)	real estate costs	0
b)	development costs	0
	total real estate	**0**

1.3 construction		**€ net**
a)	buildings	2.000.000
b)	outside facilities	400.000
c)	civil engineering	200.000
	total construction	**2.600.000**

1.4 engineering services		**€ net**
a)	architect and engineering services	830.000
b)	permission and surveys	0
c)	additional construction costs	0
d)	start-up costs of project	0
	total engineering services	**830.000**

		€ net
subtotal		**14.660.000**
miscellaneous	**2,5%**	**366.500**
overall investment		**15.026.500**

2. financing plan

2.1 subsidies		**€ net**
a)	overall investment	15.026.500
b)	eligible investment volume	7.333.333
c)	quota of eligible investment	50,0%
	total subsidies	**3.666.667**

2.2 additional charges		**€ net**
a)	financing costs (0,5%)	41.351
b)	interest during investment period (5,0%)	413.514
c)	miscellaneous	
	total additional charges	**454.866**

2.3 financing			**€ net**
a)	investment volume to be financed		11.814.699
b)	equity capital	30%	3.544.410
c)	loan capital	70%	8.270.289
	overall investment minus subsidies		**11.814.699**

	€ net
overall investment incl. additonal charges	**15.481.366**
subsidies	**3.666.667**
total amount to be financed	**11.814.699**
equity capital	**3.544.410**
loan capital	**8.270.289**

biomass combined heat and power plant
profitability assessment
project: 1260_LI_Smethport
amortization schedule (T€)
status quo: 27. November 2009

alternative 2: steam boiler with heating type turbine
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I. time schedule

I. time schedule		2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
1. quarter	status quo of investment	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2. quarter	status quo of investment	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
3. quarter	status quo of investment	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
4. quarter	status quo of investment	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
investments per year		**0%**	**100%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**
status quo of investment at end of year		**0%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

II. amortization calculation

loan capital	**8.270**	**T€**
interest	6,00%	
payout	100%	
life of loan	15	years
number of installme	4	times/year
annuity	210	T€/quarter
	10,30	%

		2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
1. quarter	status quo of loan	0	8.270	7.919	7.545	7.149	6.729	6.283	5.809	5.306	4.773	4.207	3.606	2.968	2.291	1.572	809	0
	interest	0	124	119	113	107	101	94	87	80	72	63	54	45	34	24	12	0
	amortization	0	86	91	97	103	109	116	123	130	138	147	156	165	176	186	198	0
	annuity	0	210	210	210	210	210	210	210	210	210	210	210	210	210	210	210	0
2. quarter	status quo of loan	0	8.184	7.827	7.449	7.047	6.620	6.167	5.686	5.176	4.634	4.060	3.450	2.802	2.115	1.386	612	0
	interest	0	123	117	112	106	99	93	85	78	70	61	52	42	32	21	9	0
	amortization	0	87	93	98	104	111	118	125	132	140	149	158	168	178	189	201	0
	annuity	0	210	210	210	210	210	210	210	210	210	210	210	210	210	210	210	0
3. quarter	status quo of loan	0	8.097	7.735	7.350	6.942	6.509	6.049	5.561	5.044	4.494	3.911	3.291	2.634	1.937	1.196	411	0
	interest	0	121	116	110	104	98	91	83	76	67	59	49	40	29	18	6	0
	amortization	0	89	94	100	106	112	119	127	134	143	151	161	170	181	192	204	0
	annuity	0	210	210	210	210	210	210	210	210	210	210	210	210	210	210	210	0
4. quarter	status quo of loan	0	8.009	7.641	7.251	6.836	6.397	5.930	5.435	4.909	4.351	3.759	3.131	2.464	1.756	1.004	207	0
	interest	0	120	115	109	103	96	89	82	74	65	56	47	37	26	15	3	0
	amortization	0	90	95	101	107	114	121	128	136	145	154	163	173	184	195	207	0
	annuity	0	210	210	210	210	210	210	210	210	210	210	210	210	210	210	210	0
status quo of loan at end of year		**0**	**7.919**	**7.545**	**7.149**	**6.729**	**6.283**	**5.809**	**5.306**	**4.773**	**4.207**	**3.606**	**2.968**	**2.291**	**1.572**	**809**	**0**	**0**
	interest per year	0	488	467	444	420	394	366	337	307	274	239	202	163	121	77	31	0
	amortization per year	0	352	373	396	420	446	474	503	534	566	601	638	677	719	763	809	0
	annuity per year	0	840	840	840	840	840	840	840	840	840	840	840	840	840	840	840	0

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I. interest on partner's loan (equity capital)

1. composition of loan (equity capital)	absolut	in percent
a.) partner A	**3.544 T€**	100,0 %
b.) partner B	0 **T€**	0,0 %
c.) partner C	0 **T€**	0,0 %
loan	**3.544** T€	100,0 %
interest rate	10,00 %	
life of loan	15 Jahre	

	2011	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*	*2021*	*2022*	*2023*	*2024*	*2025*	*2026*	*2027*
2. interest on partner's loan [€/a]	0	266	354	354	354	354	354	354	354	354	354	354	354	354	354	354	89

II depreciation

1. depreciation parameters

a.) depreciation type	linear
b.) recovery period	15 years
c.) depreciable amount	15.481 T€

	2011	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*	*2021*	*2022*	*2023*	*2024*	*2025*	*2026*	*2027*
2. annual depreciation [€/a]	0	774	1.032	1.032	1.032	1.032	1.032	1.032	1.032	1.032	1.032	1.032	1.032	1.032	1.032	1.032	258

biomass combined heat and power plant

profitability assessment

project: 1260_LI_Smethport

revenues (T€)

status 27. November 2009

alternative 2: steam boiler with heating type turbine

load point 1: dimensioning

begin of operatioı 01.04.2012

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					2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
I. general conditions				workload	0%	75%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	25%
operating hours																					
biomass CHP plant	h/a	8.000			0	6.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	2.000
power generation	h/a	8.000			0	6.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	2.000
heat generation	h/a	8.760			0	6.570	8.760	8.760	8.760	8.760	8.760	8.760	8.760	8.760	8.760	8.760	8.760	8.760	8.760	8.760	2.190
redundancy boiler	h/a	760			0	570	760	760	760	760	760	760	760	760	760	760	760	760	760	760	190
II. revenues				price inflation																	
1. power feed-in																					
average capacity	MW	2,603			0,000	2,603	2,603	2,603	2,603	2,603	2,603	2,603	2,603	2,603	2,603	2,603	2,603	2,603	2,603	2,603	2,603
annual power generation	MWh/a	20.824			0	15.618	20.824	20.824	20.824	20.824	20.824	20.824	20.824	20.824	20.824	20.824	20.824	20.824	20.824	20.824	5.206
power feed-in tariff	€/MWh	86,67		0,0%	0,00	86,67	86,67	86,67	86,67	86,67	86,67	86,67	86,67	86,67	86,67	86,67	86,67	86,67	86,67	86,67	86,67
revenues from power feed-i	T€/a		**1.805**		**0**	**1.354**	**1.805**	**1.805**	**1.805**	**1.805**	**1.805**	**1.805**	**1.805**	**1.805**	**1.805**	**1.805**	**1.805**	**1.805**	**1.805**	**1.805**	**451**
2. heat sale																					
average capacity	MW	3,74		0,0%	0,00	3,74	3,74	3,74	3,74	3,74	3,74	3,74	3,74	3,74	3,74	3,74	3,74	3,74	3,74	3,74	3,74
annual heat supply	MWh/a	32.725			0	24.544	32.725	32.725	32.725	32.725	32.725	32.725	32.725	32.725	32.725	32.725	32.725	32.725	32.725	32.725	8.181
heat price	€/MWh	44,15		0,0%	0,00	44,15	44,15	44,15	44,15	44,15	44,15	44,15	44,15	44,15	44,15	44,15	44,15	44,15	44,15	44,15	44,15
revenues from heat sale	T€/a		**1.445**		**0**	**1.084**	**1.445**	**1.445**	**1.445**	**1.445**	**1.445**	**1.445**	**1.445**	**1.445**	**1.445**	**1.445**	**1.445**	**1.445**	**1.445**	**1.445**	**361**
3. fuel saving (fuel oil etc.)																					
annual fuel saving	Tl/a	3.943			0	2.957	3.943	3.943	3.943	3.943	3.943	3.943	3.943	3.943	3.943	3.943	3.943	3.943	3.943	3.943	986
fuel price	€/l			0,0%	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
revenues from fuel saving	T€/a		**0**		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
4. sale of green certificates																					
certificates per year	pieces	0			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
price per certificate	€/piece	0		0,0%	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
revenues from sale of greer	T€/a		**0**		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
III. total revenues	**T€/a**		**3.250**		**0**	**2.437**	**3.250**	**3.250**	**3.250**	**3.250**	**3.250**	**3.250**	**3.250**	**3.250**	**3.250**	**3.250**	**3.250**	**3.250**	**3.250**	**3.250**	**812**

biomass combined heat and power plant

profitability assessment

project: 1260_LI_Smethport — **alternative 2: steam boiler with heating type turbine**

operating costs (T€) — **load point 1: dimensioning**

status (27. November 2009 — begin of operation 01.04.2012

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	unit	value	total		2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
I. general conditions				workload	0%	75%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	25%
design data																					
operating hours CHP	h/a	8.000			0	6.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	2.000
average fuel power input	MW	13,1		0,0%	0,0	13,1	13,1	13,1	13,1	13,1	13,1	13,1	13,1	13,1	13,1	13,1	13,1	13,1	13,1	13,1	13,1
annual fuel energy	MWh/a	104.800			0	78.600	104.800	104.800	104.800	104.800	104.800	104.800	104.800	104.800	104.800	104.800	104.800	104.800	104.800	104.800	26.200
redundancy boiler	h/a	760			0	570	760	760	760	760	760	760	760	760	760	760	760	760	760	760	190
II. usage-bound costs				price inflation																	
1. fuel supply																					
average calorific value of fuel	MWh/t	2,3																			
required amount of fuel	t/a	45.565			0	34.174	45.565	45.565	45.565	45.565	45.565	45.565	45.565	45.565	45.565	45.565	45.565	45.565	45.565	45.565	11.391
specific fuel costs	€/t	23,33		0,0%	0,00	23,33	23,33	23,33	23,33	23,33	23,33	23,33	23,33	23,33	23,33	23,33	23,33	23,33	23,33	23,33	23,33
costs of fuel supply	T€/a		**1.063**		**0**	**797**	**1.063**	**1.063**	**1.063**	**1.063**	**1.063**	**1.063**	**1.063**	**1.063**	**1.063**	**1.063**	**1.063**	**1.063**	**1.063**	**1.063**	**266**
2. power supply																					
average capacity	kW	400			0	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400
annual power requirement	MWh/a	3.200			0	2.400	3.200	3.200	3.200	3.200	3.200	3.200	3.200	3.200	3.200	3.200	3.200	3.200	3.200	3.200	800
specific electricity costs	€/MWh	53,33		0,0%	0,00	53,33	53,33	53,33	53,33	53,33	53,33	53,33	53,33	53,33	53,33	53,33	53,33	53,33	53,33	53,33	53,33
costs of power supply	T€/a		**171**		**0**	**128**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**43**
3. ash disposal																					
annual amount of ash	t/a	2.278			0	1.709	2.278	2.278	2.278	2.278	2.278	2.278	2.278	2.278	2.278	2.278	2.278	2.278	2.278	2.278	570
specific costs of ash disposal	€/t	13,33		0,0%	0,00	13,33	13,33	13,33	13,33	13,33	13,33	13,33	13,33	13,33	13,33	13,33	13,33	13,33	13,33	13,33	13,33
costs of ash disposal	T€/a		**30**		**0**	**23**	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**8**
4. water treatment																					
water amount treated per hour	m^3/h	1,5			1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5
specific costs of water treatment	$€/m^3$	4,00		0,0%	0,00	4,00	4,00	4,00	4,00	4,00	4,00	4,00	4,00	4,00	4,00	4,00	4,00	4,00	4,00	4,00	4,00
costs of water treatment	T€/a		**48**		**0**	**36**	**48**	**48**	**48**	**48**	**48**	**48**	**48**	**48**	**48**	**48**	**48**	**48**	**48**	**48**	**12**
5. peak load / redundancy covering																					
annual heat capacity of fuel	MWh/a	6.400			0	4.800	6.400	6.400	6.400	6.400	6.400	6.400	6.400	6.400	6.400	6.400	6.400	6.400	6.400	6.400	1.600
specific costs of heat capacity	€/MWh	26,67		0,0%	0,00	26,67	26,67	26,67	26,67	26,67	26,67	26,67	26,67	26,67	26,67	26,67	26,67	26,67	26,67	26,67	26,67
costs of peak load / redundancy coveri	T€/a		**171**		**0**	**128**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**43**
6. operating supplies	T€/a	25	**25**	0,0%	**0**	**19**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**6**
III. subtotal operating costs	T€/a		**1.508**		**0**	**1.131**	**1.508**	**1.508**	**1.508**	**1.508**	**1.508**	**1.508**	**1.508**	**1.508**	**1.508**	**1.508**	**1.508**	**1.508**	**1.508**	**1.508**	**377**

biomass combined heat and power plant

profitability assessment

project: 1260_LI_Smethport — **alternative 2: steam boiler with heating type turbine**

operating costs (T€) — **load point 1: dimensioning**

status 27. November 2009 — begin of operatior 01.04.2012

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					2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
IV. general conditions				workload	0%	75%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	25%
design data																					
operating hours CHP	h/a	8.000			0	6.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	2.000
average fuel power input	MW	13,1		0,0%	0,0	13,1	13,1	13,1	13,1	13,1	13,1	13,1	13,1	13,1	13,1	13,1	13,1	13,1	13,1	13,1	13,1
annual fuel energy	MWh/a	104.800			0	78.600	104.800	104.800	104.800	104.800	104.800	104.800	104.800	104.800	104.800	104.800	104.800	104.800	104.800	104.800	26.200
redundancy boiler	h/a	760			0	570	760	760	760	760	760	760	760	760	760	760	760	760	760	760	190
V. operating costs				price inflation																	
1. salaries and wages																					
personnel requirement	employees	6,0			0	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
labor costs	T€/a employee	40		0,0%	0	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40
operating costs	T€/a		**240**		**0**	**180**	**240**	**240**	**240**	**240**	**240**	**240**	**240**	**240**	**240**	**240**	**240**	**240**	**240**	**240**	**60**
2. service and maintenance																					
specific costs as % of investment	%	1,5		0,0%	0,0	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5
costs of service and maintenance	T€/a		**207**		**0**	**156**	**207**	**207**	**207**	**207**	**207**	**207**	**207**	**207**	**207**	**207**	**207**	**207**	**207**	**207**	**52**
3. miscellaneous																					
management	T€/a			0,0%	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
insurance	T€/a	0		0,0%	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
total miscellaneous costs	T€/a		**0**		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
VI. subtotal operating costs	T€/a		**447**		**0**	**336**	**447**	**447**	**447**	**447**	**447**	**447**	**447**	**447**	**447**	**447**	**447**	**447**	**447**	**447**	**112**
VII total operating costs	T€/a		**1.955**		**0**	**1.467**	**1.955**	**1.955**	**1.955**	**1.955**	**1.955**	**1.955**	**1.955**	**1.955**	**1.955**	**1.955**	**1.955**	**1.955**	**1.955**	**1.955**	**489**

biomass combined heat and power plant
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			2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
I.	**revenues**																		
1.	revenues from power feed-in	T€/a	0	1.354	1.805	1.805	1.805	1.805	1.805	1.805	1.805	1.805	1.805	1.805	1.805	1.805	1.805	1.805	451
2.	revenues from heat sale	T€/a	0	1.084	1.445	1.445	1.445	1.445	1.445	1.445	1.445	1.445	1.445	1.445	1.445	1.445	1.445	1.445	361
3.	revenues from fuel saving	T€/a	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4.	revenues from sale of green certificates	T€/a	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	total revenues	**T€/a**	**0**	**2.437**	**3.250**	**3.250**	**3.250**	**3.250**	**3.250**	**3.250**	**3.250**	**3.250**	**3.250**	**3.250**	**3.250**	**3.250**	**3.250**	**3.250**	**812**
II.	**costs**																		
1.	costs of fuel supply	T€/a	0	797	1.063	1.063	1.063	1.063	1.063	1.063	1.063	1.063	1.063	1.063	1.063	1.063	1.063	1.063	266
2.	costs of power supply	T€/a	0	128	171	171	171	171	171	171	171	171	171	171	171	171	171	171	43
3.	costs of ash disposal	T€/a	0	23	30	30	30	30	30	30	30	30	30	30	30	30	30	30	8
4.	costs of water treatment	T€/a	0	36	48	48	48	48	48	48	48	48	48	48	48	48	48	48	12
5.	costs of peak load / redundancy covering	T€/a	0	128	171	171	171	171	171	171	171	171	171	171	171	171	171	171	43
6.	costs of operating supplies	T€/a	0	19	25	25	25	25	25	25	25	25	25	25	25	25	25	25	6
7.	operating costs	T€/a	0	180	240	240	240	240	240	240	240	240	240	240	240	240	240	240	60
8.	costs of service and maintenance	T€/a	0	156	207	207	207	207	207	207	207	207	207	207	207	207	207	207	52
9.	costs of management	T€/a	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10.	insurance costs	T€/a	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11.	depreciation	T€/a	0	774	1.032	1.032	1.032	1.032	1.032	1.032	1.032	1.032	1.032	1.032	1.032	1.032	1.032	1.032	258
12.	interests on loan capital	T€/a	0	488	467	444	420	394	366	337	307	274	239	202	163	121	77	31	0
13.	interests on partner's loan	T€/a	0	266	354	354	354	354	354	354	354	354	354	354	354	354	354	354	89
	overall costs	**T€/a**	**0**	**2.995**	**3.809**	**3.786**	**3.761**	**3.736**	**3.708**	**3.679**	**3.648**	**3.616**	**3.581**	**3.544**	**3.505**	**3.463**	**3.419**	**3.372**	**835**
III.	**annual result**																		
1.	total revenues	T€/a	0	2.437	3.250	3.250	3.250	3.250	3.250	3.250	3.250	3.250	3.250	3.250	3.250	3.250	3.250	3.250	812
2.	overall costs	T€/a	0	-2.995	-3.809	-3.786	-3.761	-3.736	-3.708	-3.679	-3.648	-3.616	-3.581	-3.544	-3.505	-3.463	-3.419	-3.372	-835
		T€/a	**0**	**-558**	**-559**	**-536**	**-512**	**-486**	**-459**	**-430**	**-399**	**-366**	**-331**	**-294**	**-255**	**-214**	**-170**	**-123**	**-23**

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			2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
IV.	**cash flow before debt service (loan capital)**																		
1.	annual result	T€/a	0	-558	-559	-536	-512	-486	-459	-430	-399	-366	-331	-294	-255	-214	-170	-123	-23
2.	depreciation	T€/a	0	774	1.032	1.032	1.032	1.032	1.032	1.032	1.032	1.032	1.032	1.032	1.032	1.032	1.032	1.032	258
3.	interests on loan capital	T€/a	0	488	467	444	420	394	366	337	307	274	239	202	163	121	77	31	0
4.	interests on partner's loan	T€/a	0	266	354	354	354	354	354	354	354	354	354	354	354	354	354	354	89
	cash flow before debt service (loan capital)	**T€/a**	**0**	**971**	**1.294**	**1.294**	**1.294**	**1.294**	**1.294**	**1.294**	**1.294**	**1.294**	**1.294**	**1.294**	**1.294**	**1.294**	**1.294**	**1.294**	**324**
V.	**debt service (loan capital)**																		
1.	interests	T€/a	0	488	467	444	420	394	366	337	307	274	239	202	163	121	77	31	0
2.	amortization	T€/a	0	352	373	396	420	446	474	503	534	566	601	638	677	719	763	809	0
	annual debt service	**T€/a**	**0**	**840**	**840**	**840**	**840**	**840**	**840**	**840**	**840**	**840**	**840**	**840**	**840**	**840**	**840**	**840**	**0**
	status quo of loan at end of year	**T€**	**0**	**7.919**	**7.545**	**7.149**	**6.729**	**6.283**	**5.809**	**5.306**	**4.773**	**4.207**	**3.606**	**2.968**	**2.291**	**1.572**	**809**	**0**	**0**
VI.	**cash flow after debt service (loan capital)**																		
1.	cash flow before debt service (loan capital)	T€/a	0	971	1.294	1.294	1.294	1.294	1.294	1.294	1.294	1.294	1.294	1.294	1.294	1.294	1.294	1.294	324
2.	debt service (loan capital)	T€/a	0	-840	-840	-840	-840	-840	-840	-840	-840	-840	-840	-840	-840	-840	-840	-840	0
	cash flow after debt service (loan capital)	**T€/a**	**0**	**131**	**454**	**454**	**454**	**454**	**454**	**454**	**454**	**454**	**454**	**454**	**454**	**454**	**454**	**454**	**324**
VII.	**cash flow after debt service and interest on partner's loan**																		
1.	cash flow after debt service (loan capital)	T€/a	0	131	454	454	454	454	454	454	454	454	454	454	454	454	454	454	324
2.	interest on partner's loan	T€/a	0	-266	-354	-354	-354	-354	-354	-354	-354	-354	-354	-354	-354	-354	-354	-354	-89
	cash flow after debt service and interest on	**T€/a**	**0**	**-135**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**235**
VIII.	**growths in equity**																		
1.	investments per year	T€/a	0	-3.544	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.	cash flow after debt service (loan capital)	T€/a	0	131	454	454	454	454	454	454	454	454	454	454	454	454	454	454	324
	growths in equity	**T€/a**	**0**	**-3.414**	**454**	**454**	**454**	**454**	**454**	**454**	**454**	**454**	**454**	**454**	**454**	**454**	**454**	**454**	**324**
	growths in equity accumulated	**T€**	**0**	**-3.414**	**-2.960**	**-2.505**	**-2.051**	**-1.597**	**-1.143**	**-689**	**-235**	**220**	**674**	**1.128**	**1.582**	**2.036**	**2.490**	**2.944**	**3.268**
IX.	**internal rate of return**																		
1.	growths in equity	T€/a	0	-3.414	454	454	454	454	454	454	454	454	454	454	454	454	454	454	324
	internal rate of return		**10,0%**																
	(from cash flow + interest on equity capital)																		

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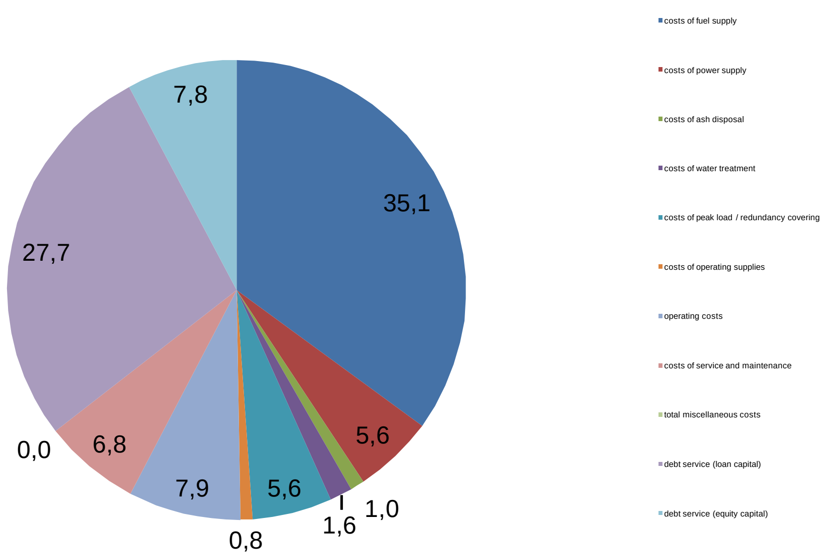
A. marginal costing

a)	heat output	32.725 MWh/a		

	specific costs of heat generation	[T€/a]	[€/MWh]	[%]
a)	costs of fuel supply	1.063	32,49	35,1
b)	costs of power supply	171	5,22	5,6
c)	costs of ash disposal	30	0,93	1,0
d)	costs of water treatment	48	1,47	1,6
e)	costs of peak load / redundancy covering	171	5,22	5,6
f)	costs of operating supplies	25	0,76	0,8
g)	operating costs	240	7,33	7,9
h)	costs of service and maintenance	207	6,34	6,8
i)	total miscellaneous costs	0	0,00	0,0
	total operating costs	**1.955**	**59,75**	**64,5**
j)	debt service (loan capital)	840	25,67	27,7
k)	debt service (equity capital)	236	7,22	7,8
	costs of capital	**1.076**	**32,89**	**35,5**
	marginal costing of heat generation	**3.032**	**92,64**	**100**
	(without power feed-in)			
k)	revenues from power feed-in	1.805	55,15	60
k)	revenues from fuel saving	0	0,00	0
l)	revenues from sale of green certificates	0	0,00	0
	marginal costing of heat generation	**1.227**	**37,49**	**40**
	(with power feed-in)			

Wesentliche spezifische Kosten der Wärmegestehung in %

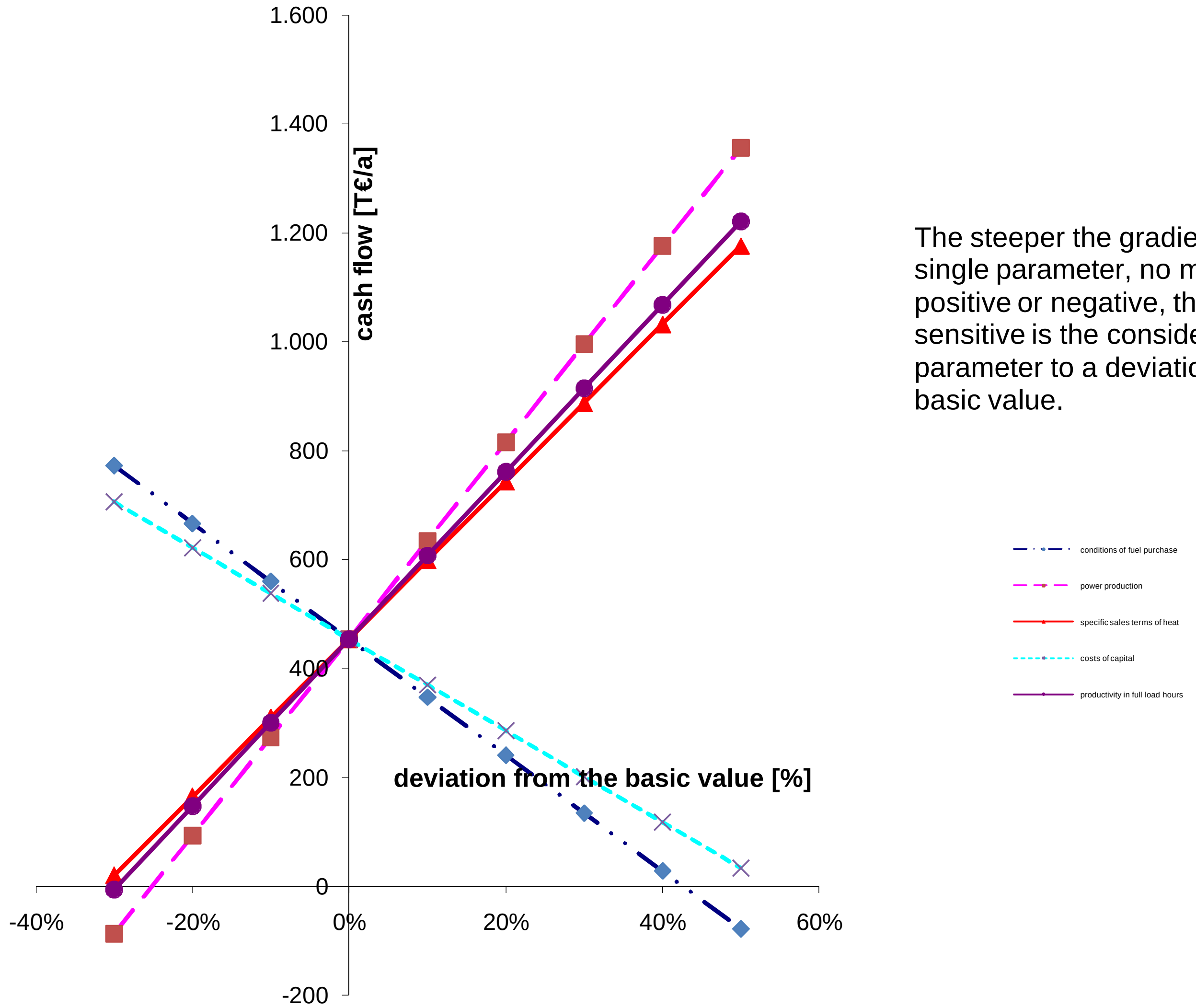


B. sensitivity analysis

cash flow after debt service (loan capi **454 T€/a** (basic value)

output parameter	unit	value ∅	-30%	-20%	-10%	0%	10%	20%	30%	40%	50%
			productivity in full load hours								
conditions of fuel purchase	€/MWh	23,33	773	667	560	454	348	242	135	29	-77
power production	TMWh/a	21	-87	93	274	454	635	815	996	1.176	1.357
specific sales terms of heat	€/MWh	44,15	21	165	310	454	599	743	888	1.032	1.177
costs of capital	€/a	840	706	622	538	454	370	286	202	118	34
productivity in full load hours	h/a	8.000	-6	147	301	454	608	761	914	1.068	1.221

Sensitivity of the cash flow to the deviation of single parameters



The steeper the gradient of one single parameter, no matter if positive or negative, the more sensitive is the considered parameter to a deviation from the basic value.

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1. investment cost estimate biomass heat and power pla

HKW (Dampf-Kraft-Prozess) 22,0 MW FWL

1.1 technology		€ net
a)	separator for impurities (overlengths, ferrous m	0
b)	fuel storage and transport	650.000
c)	furnace and boiler	6.055.000
d)	flue gas cleaning (electrostatic precipitator)	605.000
e)	emission measurement	100.000
f)	flue gas discharge	65.000
g)	water treatment	150.000
h)	power generation	2.850.000
i)	vacuum condenser	1.840.000
j)	heat exchanger / cooler	0
k)	piping and heat distribution	900.000
l)	switchgear, transformer, cabeling	700.000
m)	process control enginnering	150.000
n)	compressed air generation	40.000
o)	crane (turbine house)	35.000
p)	fire extinguishing installation	50.000
q)	building services	150.000
r)	wheel loader	160.000
s)	biomass hot water boiler	0
t)	gas-fired peak load boiler	250.000
u)	truck weigh station	35.000
v)	emergency power supply	40.000
w)	heat grid	0
x)	transfer station	0
y)	truck dumper	700.000
z)		0
	total technology	**15.525.000**

unconsidered options

separator for impurities (overlengths, ferrous m	300.000
silo for ashes	300.000
SNCR nitrogen oxide reduction facility	250.000

* all information based on current estimated prices

1.2 real estate		€ net
a)	real estate costs	0
b)	development costs	0
	total real estate	**0**

1.3 construction		€ net
a)	buildings	2.500.000
b)	outside facilities	500.000
c)	civil engineering	300.000
	total construction	**3.300.000**

1.4 engineering services		€ net
a)	architect and engineering services	1.110.000
b)	permission and surveys	0
c)	additional construction costs	0
d)	start-up costs of project	0
	total engineering services	**1.110.000**

		€ net
subtotal		**19.935.000**
miscellaneous	**2,5%**	**498.375**
overall investment		**20.433.375**

2. financing plan

2.1 subsidies		€ net
a)	overall investment	20.433.375
b)	eligible investment volume	7.333.333
c)	quota of eligible investment	50,0%
	total subsidies	**3.666.667**

2.2 additional charges		€ net
a)	financing costs (0,5%)	61.033
b)	interest during investment period (5,0%)	610.333
c)	miscellaneous	
	total additional charges	**671.366**

2.3 financing			€ net
a)	investment volume to be financed		17.438.074
b)	equity capital	30%	5.231.422
c)	loan capital	70%	12.206.652
	overall investment minus subsidies		**17.438.074**

	€ net
overall investment incl. additonal charges	**21.104.741**
subsidies	**3.666.667**
total amount to be financed	**17.438.074**
equity capital	**5.231.422**
loan capital	**12.206.652**

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I. time schedule		2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
1. quarter	status quo of investment	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2. quarter	status quo of investment	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
3. quarter	status quo of investment	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
4. quarter	status quo of investment	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
investments per year		**0%**	**100%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**
status quo of investment at end of year		**0%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

II. amortization calculation

loan capital	**12.207**	**T€**
interest	6,00%	
payout	100%	
life of loan	15	years
number of installme	4	times/year
annuity	310	T€/quarter
	10,30	%

		2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
1. quarter	status quo of loan	0	12.207	11.688	11.137	10.552	9.932	9.273	8.574	7.832	7.045	6.209	5.322	4.380	3.381	2.320	1.195	0
	interest	0	183	175	167	158	149	139	129	117	106	93	80	66	51	35	18	0
	amortization	0	127	135	143	152	161	171	181	192	204	217	230	244	259	275	292	0
	annuity	0	310	310	310	310	310	310	310	310	310	310	310	310	310	310	310	0
2. quarter	status quo of loan	0	12.080	11.553	10.994	10.400	9.771	9.102	8.393	7.640	6.840	5.992	5.092	4.136	3.122	2.045	903	0
	interest	0	181	173	165	156	147	137	126	115	103	90	76	62	47	31	14	0
	amortization	0	129	137	145	154	163	173	184	195	207	220	234	248	263	279	296	0
	annuity	0	310	310	310	310	310	310	310	310	310	310	310	310	310	310	310	0
3. quarter	status quo of loan	0	11.951	11.416	10.849	10.246	9.607	8.929	8.209	7.444	6.633	5.772	4.858	3.888	2.859	1.766	606	0
	interest	0	179	171	163	154	144	134	123	112	99	87	73	58	43	26	9	0
	amortization	0	131	139	147	156	166	176	187	198	210	223	237	252	267	283	301	0
	annuity	0	310	310	310	310	310	310	310	310	310	310	310	310	310	310	310	0
4. quarter	status quo of loan	0	11.820	11.278	10.702	10.090	9.441	8.753	8.022	7.246	6.422	5.548	4.621	3.636	2.591	1.482	305	0
	interest	0	177	169	161	151	142	131	120	109	96	83	69	55	39	22	5	0
	amortization	0	133	141	149	159	168	179	190	201	214	227	241	255	271	288	305	0
	annuity	0	310	310	310	310	310	310	310	310	310	310	310	310	310	310	310	0
status quo of loan at end of year		**0**	**11.688**	**11.137**	**10.552**	**9.932**	**9.273**	**8.574**	**7.832**	**7.045**	**6.209**	**5.322**	**4.380**	**3.381**	**2.320**	**1.195**	**0**	**0**
	interest per year	0	721	689	655	619	581	541	498	452	404	353	298	241	179	114	45	0
	amortization per year	0	519	551	585	621	659	699	742	787	836	887	941	999	1.061	1.126	1.195	0
	annuity per year	0	1.240	1.240	1.240	1.240	1.240	1.240	1.240	1.240	1.240	1.240	1.240	1.240	1.240	1.240	1.240	0

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I. interest on partner's loan (equity capital)

1. composition of loan (equity capital)	absolut		in percent	
a.) partner A	**5.231**	**T€**	100,0	%
b.) partner B	0	**T€**	0,0	%
c.) partner C	0	**T€**	0,0	%
loan	**5.231**	T€	100,0	%
interest rate	10,00	%		
life of loan	15	Jahre		

	2011	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*	*2021*	*2022*	*2023*	*2024*	*2025*	*2026*	*2027*
2. interest on partner's loan [€/a]	0	392	523	523	523	523	523	523	523	523	523	523	523	523	523	523	131

II depreciation

1. depreciation parameters

a.) depreciation type	linear	
b.) recovery period	15	years
c.) depreciable amount	21.105	T€

	2011	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*	*2021*	*2022*	*2023*	*2024*	*2025*	*2026*	*2027*
2. annual depreciation [€/a]	0	1.055	1.407	1.407	1.407	1.407	1.407	1.407	1.407	1.407	1.407	1.407	1.407	1.407	1.407	1.407	352

biomass combined heat and power plant

profitability assessment

project: 1260_LI_Smethport

alternative 3: steam boiler with condensing type turbine

revenues (T€)

load point 1: dimensioning

status 27. November 2009

begin of operatioı 01.04.2012

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					2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
I. general conditions				workload	0%	75%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	25%
operating hours																					
biomass CHP plant	h/a	8.000			0	6.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	2.000
power generation	h/a	8.000			0	6.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	2.000
heat generation	h/a	8.760			0	6.570	8.760	8.760	8.760	8.760	8.760	8.760	8.760	8.760	8.760	8.760	8.760	8.760	8.760	8.760	2.190
redundancy boiler	h/a	760			0	570	760	760	760	760	760	760	760	760	760	760	760	760	760	760	190
II. revenues				price inflation																	
1. power feed-in																					
average capacity	MW	4,866			0,000	4,866	4,866	4,866	4,866	4,866	4,866	4,866	4,866	4,866	4,866	4,866	4,866	4,866	4,866	4,866	4,866
annual power generation	MWh/a	38.928			0	29.196	38.928	38.928	38.928	38.928	38.928	38.928	38.928	38.928	38.928	38.928	38.928	38.928	38.928	38.928	9.732
power feed-in tariff	€/MWh	86,67		0,0%	0,00	86,67	86,67	86,67	86,67	86,67	86,67	86,67	86,67	86,67	86,67	86,67	86,67	86,67	86,67	86,67	86,67
revenues from power feed-i	T€/a		**3.374**		**0**	**2.530**	**3.374**	**3.374**	**3.374**	**3.374**	**3.374**	**3.374**	**3.374**	**3.374**	**3.374**	**3.374**	**3.374**	**3.374**	**3.374**	**3.374**	**843**
2. heat sale																					
average capacity	MW	3,74		0,0%	0,00	3,74	3,74	3,74	3,74	3,74	3,74	3,74	3,74	3,74	3,74	3,74	3,74	3,74	3,74	3,74	3,74
annual heat supply	MWh/a	32.725			0	24.544	32.725	32.725	32.725	32.725	32.725	32.725	32.725	32.725	32.725	32.725	32.725	32.725	32.725	32.725	8.181
heat price	€/MWh	40,10		0,0%	0,00	40,10	40,10	40,10	40,10	40,10	40,10	40,10	40,10	40,10	40,10	40,10	40,10	40,10	40,10	40,10	40,10
revenues from heat sale	T€/a		**1.312**		**0**	**984**	**1.312**	**1.312**	**1.312**	**1.312**	**1.312**	**1.312**	**1.312**	**1.312**	**1.312**	**1.312**	**1.312**	**1.312**	**1.312**	**1.312**	**328**
3. fuel saving (fuel oil etc.)																					
annual fuel saving	Tl/a	3.943			0	2.957	3.943	3.943	3.943	3.943	3.943	3.943	3.943	3.943	3.943	3.943	3.943	3.943	3.943	3.943	986
fuel price	€/l			0,0%	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
revenues from fuel saving	T€/a		**0**		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
4. sale of green certificates																					
certificates per year	pieces	0			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
price per certificate	€/piece	0		0,0%	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
revenues from sale of greer	T€/a		**0**		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
III. total revenues	**T€/a**		**4.686**		**0**	**3.515**	**4.686**	**4.686**	**4.686**	**4.686**	**4.686**	**4.686**	**4.686**	**4.686**	**4.686**	**4.686**	**4.686**	**4.686**	**4.686**	**4.686**	**1.172**

biomass combined heat and power plant

profitability assessment

project: 1260_LI_Smethport

alternative 3: steam boiler with condensing type turbine

operating costs (T€)

load point 1: dimensioning

status ı 27. November 2009

begin of operation 01.04.2012

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	unit	value	total		2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
I. general conditions				workload	0%	75%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	25%
design data																					
operating hours CHP	h/a	8.000			0	6.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	2.000
average fuel power input	MW	20,6		0,0%	0,0	20,6	20,6	20,6	20,6	20,6	20,6	20,6	20,6	20,6	20,6	20,6	20,6	20,6	20,6	20,6	20,6
annual fuel energy	MWh/a	164.992			0	123.744	164.992	164.992	164.992	164.992	164.992	164.992	164.992	164.992	164.992	164.992	164.992	164.992	164.992	164.992	41.248
redundancy boiler	h/a	760			0	570	760	760	760	760	760	760	760	760	760	760	760	760	760	760	190
II. usage-bound costs				price inflation																	
1. fuel supply																					
average calorific value of fuel	MWh/t	2,3																			
required amount of fuel	t/a	71.736			0	53.802	71.736	71.736	71.736	71.736	71.736	71.736	71.736	71.736	71.736	71.736	71.736	71.736	71.736	71.736	17.934
specific fuel costs	€/t	23,33		0,0%	0,00	23,33	23,33	23,33	23,33	23,33	23,33	23,33	23,33	23,33	23,33	23,33	23,33	23,33	23,33	23,33	23,33
costs of fuel supply	T€/a		**1.674**		**0**	**1.255**	**1.674**	**1.674**	**1.674**	**1.674**	**1.674**	**1.674**	**1.674**	**1.674**	**1.674**	**1.674**	**1.674**	**1.674**	**1.674**	**1.674**	**418**
2. power supply																					
average capacity	kW	600			0	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600
annual power requirement	MWh/a	4.800			0	3.600	4.800	4.800	4.800	4.800	4.800	4.800	4.800	4.800	4.800	4.800	4.800	4.800	4.800	4.800	1.200
specific electricity costs	€/MWh	53,33		0,0%	0,00	53,33	53,33	53,33	53,33	53,33	53,33	53,33	53,33	53,33	53,33	53,33	53,33	53,33	53,33	53,33	53,33
costs of power supply	T€/a		**256**		**0**	**192**	**256**	**256**	**256**	**256**	**256**	**256**	**256**	**256**	**256**	**256**	**256**	**256**	**256**	**256**	**64**
3. ash disposal																					
annual amount of ash	t/a	3.587			0	2.690	3.587	3.587	3.587	3.587	3.587	3.587	3.587	3.587	3.587	3.587	3.587	3.587	3.587	3.587	897
specific costs of ash disposal	€/t	13,33		0,0%	0,00	13,33	13,33	13,33	13,33	13,33	13,33	13,33	13,33	13,33	13,33	13,33	13,33	13,33	13,33	13,33	13,33
costs of ash disposal	T€/a		**48**		**0**	**36**	**48**	**48**	**48**	**48**	**48**	**48**	**48**	**48**	**48**	**48**	**48**	**48**	**48**	**48**	**12**
4. water treatment																					
water amount treated per hour	m^3/h	2,5			2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5
specific costs of water treatment	$€/m^3$	4,00		0,0%	0,00	4,00	4,00	4,00	4,00	4,00	4,00	4,00	4,00	4,00	4,00	4,00	4,00	4,00	4,00	4,00	4,00
costs of water treatment	T€/a		**80**		**0**	**60**	**80**	**80**	**80**	**80**	**80**	**80**	**80**	**80**	**80**	**80**	**80**	**80**	**80**	**80**	**20**
5. peak load / redundancy covering																					
annual heat capacity of fuel	MWh/a	3.500			0	2.625	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	875
specific costs of heat capacity	€/MWh	26,67		0,0%	0,00	26,67	26,67	26,67	26,67	26,67	26,67	26,67	26,67	26,67	26,67	26,67	26,67	26,67	26,67	26,67	26,67
costs of peak load / redundancy coveri	T€/a		**93**		**0**	**70**	**93**	**93**	**93**	**93**	**93**	**93**	**93**	**93**	**93**	**93**	**93**	**93**	**93**	**93**	**23**
6. operating supplies	T€/a	25	**25**	0,0%	**0**	**19**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**6**
III. subtotal operating costs	T€/a		**2.176**		**0**	**1.632**	**2.176**	**2.176**	**2.176**	**2.176**	**2.176**	**2.176**	**2.176**	**2.176**	**2.176**	**2.176**	**2.176**	**2.176**	**2.176**	**2.176**	**544**

biomass combined heat and power plant

profitability assessment

project: 1260_LI_Smethport — **alternative 3: steam boiler with condensing type turbine**

operating costs (T€) — **load point 1: dimensioning**

status 27. November 2009 — begin of operatior 01.04.2012

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					2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
IV. general conditions				workload	0%	75%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	25%
design data																					
operating hours CHP	h/a	8.000			0	6.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	2.000
average fuel power input	MW	20,6		0,0%	0,0	20,6	20,6	20,6	20,6	20,6	20,6	20,6	20,6	20,6	20,6	20,6	20,6	20,6	20,6	20,6	20,6
annual fuel energy	MWh/a	164.992			0	123.744	164.992	164.992	164.992	164.992	164.992	164.992	164.992	164.992	164.992	164.992	164.992	164.992	164.992	164.992	41.248
redundancy boiler	h/a	760			0	570	760	760	760	760	760	760	760	760	760	760	760	760	760	760	190
V. operating costs				price inflation																	
1. salaries and wages																					
personnel requirement	employees	8,0			0	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
labor costs	T€/a employee	40		0,0%	0	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40
operating costs	T€/a		**320**		**0**	**240**	**320**	**320**	**320**	**320**	**320**	**320**	**320**	**320**	**320**	**320**	**320**	**320**	**320**	**320**	**80**
2. service and maintenance																					
specific costs as % of investment	%	1,5		0,0%	0,0	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5
costs of service and maintenance	T€/a		**282**		**0**	**212**	**282**	**282**	**282**	**282**	**282**	**282**	**282**	**282**	**282**	**282**	**282**	**282**	**282**	**282**	**71**
3. miscellaneous																					
management	T€/a			0,0%	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
insurance	T€/a	0		0,0%	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
total miscellaneous costs	T€/a		**0**		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
VI. subtotal operating costs	T€/a		**602**		**0**	**452**	**602**	**602**	**602**	**602**	**602**	**602**	**602**	**602**	**602**	**602**	**602**	**602**	**602**	**602**	**151**
VII total operating costs	T€/a		**2.778**		**0**	**2.084**	**2.778**	**2.778**	**2.778**	**2.778**	**2.778**	**2.778**	**2.778**	**2.778**	**2.778**	**2.778**	**2.778**	**2.778**	**2.778**	**2.778**	**695**

biomass combined heat and power plant
profitability assessment
project: 1260_LI_Smethport
profit and loss account /cash flow forecast (T€)
status quo 27. November 2009

alternative 3: steam boiler with condensing type turbine
load point 1: dimensioning
begin of operation: 01.04.2012

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			2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
I.	**revenues**																		
1.	revenues from power feed-in	T€/a	0	2.530	3.374	3.374	3.374	3.374	3.374	3.374	3.374	3.374	3.374	3.374	3.374	3.374	3.374	3.374	843
2.	revenues from heat sale	T€/a	0	984	1.312	1.312	1.312	1.312	1.312	1.312	1.312	1.312	1.312	1.312	1.312	1.312	1.312	1.312	328
3.	revenues from fuel saving	T€/a	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4.	revenues from sale of green certificates	T€/a	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	total revenues	**T€/a**	**0**	**3.515**	**4.686**	**4.686**	**4.686**	**4.686**	**4.686**	**4.686**	**4.686**	**4.686**	**4.686**	**4.686**	**4.686**	**4.686**	**4.686**	**4.686**	**1.172**
II.	**costs**																		
1.	costs of fuel supply	T€/a	0	1.255	1.674	1.674	1.674	1.674	1.674	1.674	1.674	1.674	1.674	1.674	1.674	1.674	1.674	1.674	418
2.	costs of power supply	T€/a	0	192	256	256	256	256	256	256	256	256	256	256	256	256	256	256	64
3.	costs of ash disposal	T€/a	0	36	48	48	48	48	48	48	48	48	48	48	48	48	48	48	12
4.	costs of water treatment	T€/a	0	60	80	80	80	80	80	80	80	80	80	80	80	80	80	80	20
5.	costs of peak load / redundancy covering	T€/a	0	70	93	93	93	93	93	93	93	93	93	93	93	93	93	93	23
6.	costs of operating supplies	T€/a	0	19	25	25	25	25	25	25	25	25	25	25	25	25	25	25	6
7.	operating costs	T€/a	0	240	320	320	320	320	320	320	320	320	320	320	320	320	320	320	80
8.	costs of service and maintenance	T€/a	0	212	282	282	282	282	282	282	282	282	282	282	282	282	282	282	71
9.	costs of management	T€/a	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10.	insurance costs	T€/a	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11.	depreciation	T€/a	0	1.055	1.407	1.407	1.407	1.407	1.407	1.407	1.407	1.407	1.407	1.407	1.407	1.407	1.407	1.407	352
12.	interests on loan capital	T€/a	0	721	689	655	619	581	541	498	452	404	353	298	241	179	114	45	0
13.	interests on partner's loan	T€/a	0	392	523	523	523	523	523	523	523	523	523	523	523	523	523	523	131
	overall costs	**T€/a**	**0**	**4.252**	**5.398**	**5.364**	**5.328**	**5.290**	**5.249**	**5.206**	**5.161**	**5.113**	**5.061**	**5.007**	**4.949**	**4.888**	**4.823**	**4.754**	**1.177**
III.	**annual result**																		
1.	total revenues	T€/a	0	3.515	4.686	4.686	4.686	4.686	4.686	4.686	4.686	4.686	4.686	4.686	4.686	4.686	4.686	4.686	1.172
2.	overall costs	T€/a	0	-4.252	-5.398	-5.364	-5.328	-5.290	-5.249	-5.206	-5.161	-5.113	-5.061	-5.007	-4.949	-4.888	-4.823	-4.754	-1.177
		T€/a	**0**	**-738**	**-711**	**-678**	**-642**	**-604**	**-563**	**-520**	**-475**	**-427**	**-375**	**-321**	**-263**	**-202**	**-137**	**-68**	**-6**

biomass combined heat and power plant
profitability assessment
project: 1260_LI_Smethport
profit and loss account /cash flow forecast (T€)
status quo 27. November 2009

alternative 3: steam boiler with condensing type turbine
load point 1: dimensioning
begin of operation: 01.04.2012

project manager: Carsten Besser
telephone extension - 34
e-mail: cbe@seeger.ag

SEEGER ENGINEERING AG
Industriestr. 25-27
37235 Hessisch Lichtenau
Tel: 0 56 02 / 93 79 -0
Fax: 0 56 02 / 28 89
info@seeger.ag

			2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
IV.	**cash flow before debt service (loan capital)**																		
1.	annual result	T€/a	0	-738	-711	-678	-642	-604	-563	-520	-475	-427	-375	-321	-263	-202	-137	-68	-6
2.	depreciation	T€/a	0	1.055	1.407	1.407	1.407	1.407	1.407	1.407	1.407	1.407	1.407	1.407	1.407	1.407	1.407	1.407	352
3.	interests on loan capital	T€/a	0	721	689	655	619	581	541	498	452	404	353	298	241	179	114	45	0
4.	interests on partner's loan	T€/a	0	392	523	523	523	523	523	523	523	523	523	523	523	523	523	523	131
	cash flow before debt service (loan capital)	**T€/a**	**0**	**1.431**	**1.908**	**1.908**	**1.908**	**1.908**	**1.908**	**1.908**	**1.908**	**1.908**	**1.908**	**1.908**	**1.908**	**1.908**	**1.908**	**1.908**	**477**
V.	**debt service (loan capital)**																		
1.	interests	T€/a	0	721	689	655	619	581	541	498	452	404	353	298	241	179	114	45	0
2.	amortization	T€/a	0	519	551	585	621	659	699	742	787	836	887	941	999	1.061	1.126	1.195	0
	annual debt service	**T€/a**	**0**	**1.240**	**1.240**	**1.240**	**1.240**	**1.240**	**1.240**	**1.240**	**1.240**	**1.240**	**1.240**	**1.240**	**1.240**	**1.240**	**1.240**	**1.240**	**0**
	status quo of loan at end of year	**T€**	**0**	**11.688**	**11.137**	**10.552**	**9.932**	**9.273**	**8.574**	**7.832**	**7.045**	**6.209**	**5.322**	**4.380**	**3.381**	**2.320**	**1.195**	**0**	**0**
VI.	**cash flow after debt service (loan capital)**																		
1.	cash flow before debt service (loan capital)	T€/a	0	1.431	1.908	1.908	1.908	1.908	1.908	1.908	1.908	1.908	1.908	1.908	1.908	1.908	1.908	1.908	477
2.	debt service (loan capital)	T€/a	0	-1.240	-1.240	-1.240	-1.240	-1.240	-1.240	-1.240	-1.240	-1.240	-1.240	-1.240	-1.240	-1.240	-1.240	-1.240	0
	cash flow after debt service (loan capital)	**T€/a**	**0**	**191**	**668**	**668**	**668**	**668**	**668**	**668**	**668**	**668**	**668**	**668**	**668**	**668**	**668**	**668**	**477**
VII.	**cash flow after debt service and interest on partner's loan**																		
1.	cash flow after debt service (loan capital)	T€/a	0	191	668	668	668	668	668	668	668	668	668	668	668	668	668	668	477
2.	interest on partner's loan	T€/a	0	-392	-523	-523	-523	-523	-523	-523	-523	-523	-523	-523	-523	-523	-523	-523	-131
	cash flow after debt service and interest on	**T€/a**	**0**	**-201**	**145**	**145**	**145**	**145**	**145**	**145**	**145**	**145**	**145**	**145**	**145**	**145**	**145**	**145**	**346**
VIII.	**growths in equity**																		
1.	investments per year	T€/a	0	-5.231	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.	cash flow after debt service (loan capital)	T€/a	0	191	668	668	668	668	668	668	668	668	668	668	668	668	668	668	477
	growths in equity	**T€/a**	**0**	**-5.041**	**668**	**668**	**668**	**668**	**668**	**668**	**668**	**668**	**668**	**668**	**668**	**668**	**668**	**668**	**477**
	growths in equity accumulated	**T€**	**0**	**-5.041**	**-4.373**	**-3.705**	**-3.037**	**-2.369**	**-1.702**	**-1.034**	**-366**	**302**	**970**	**1.637**	**2.305**	**2.973**	**3.641**	**4.309**	**4.785**
IX.	**internal rate of return**																		
1.	growths in equity	T€/a	0	-5.041	668	668	668	668	668	668	668	668	668	668	668	668	668	668	477
	internal rate of return		**10,0%**																
	(from cash flow + interest on equity capital)																		

biomass combined heat and power plant
profitability assessment
project: 1260_LI_Smethport
sensitivity analysis
status quc 27. November 2009

alternative 3: steam boiler with condensing type turbine
load point 1: dimensioning

project manager: Carsten Besser
telephone extensio - 34
e-mail: cbe@seeger.ag

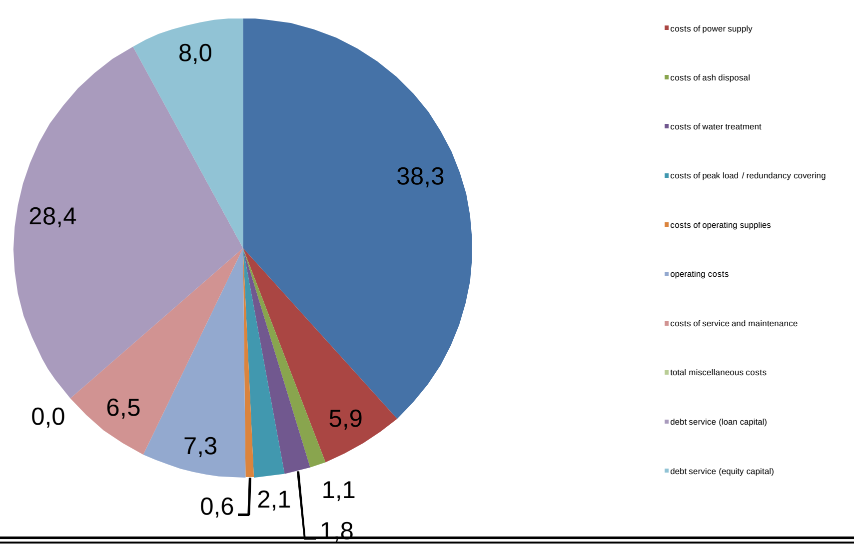
SEEGER ENGINEERING AG
Industriestr. 25-27
37235 Hessisch Lichtenau
Tel: 0 56 02 / 93 79 -0
Fax: 0 56 02 / 28 89
info@seeger.ag

A. marginal costing

a) heat output 32.725 MWh/a

	specific costs of heat generation	[T€/a]	[€/MWh]	[%]
a)	costs of fuel supply	1.674	51,15	38,3
b)	costs of power supply	256	7,82	5,9
c)	costs of ash disposal	48	1,46	1,1
d)	costs of water treatment	80	2,44	1,8
e)	costs of peak load / redundancy covering	93	2,85	2,1
f)	costs of operating supplies	25	0,76	0,6
g)	operating costs	320	9,78	7,3
h)	costs of service and maintenance	282	8,63	6,5
i)	total miscellaneous costs	0	0,00	0,0
	total operating costs	**2.778**	**84,90**	**63,6**
j)	debt service (loan capital)	1.240	37,89	28,4
k)	debt service (equity capital)	349	10,66	8,0
	costs of capital	**1.589**	**48,55**	**36,4**
	marginal costing of heat generation	**4.367**	**133,45**	**100**
	(without power feed-in)			
k)	revenues from power feed-in	3.374	103,09	77
k)	revenues from fuel saving	0	0,00	0
l)	revenues from sale of green certificates	0	0,00	0
	marginal costing of heat generation	**993**	**30,35**	**23**
	(with power feed-in)			

Wesentliche spezifische Kosten der Wärmegestehung in %

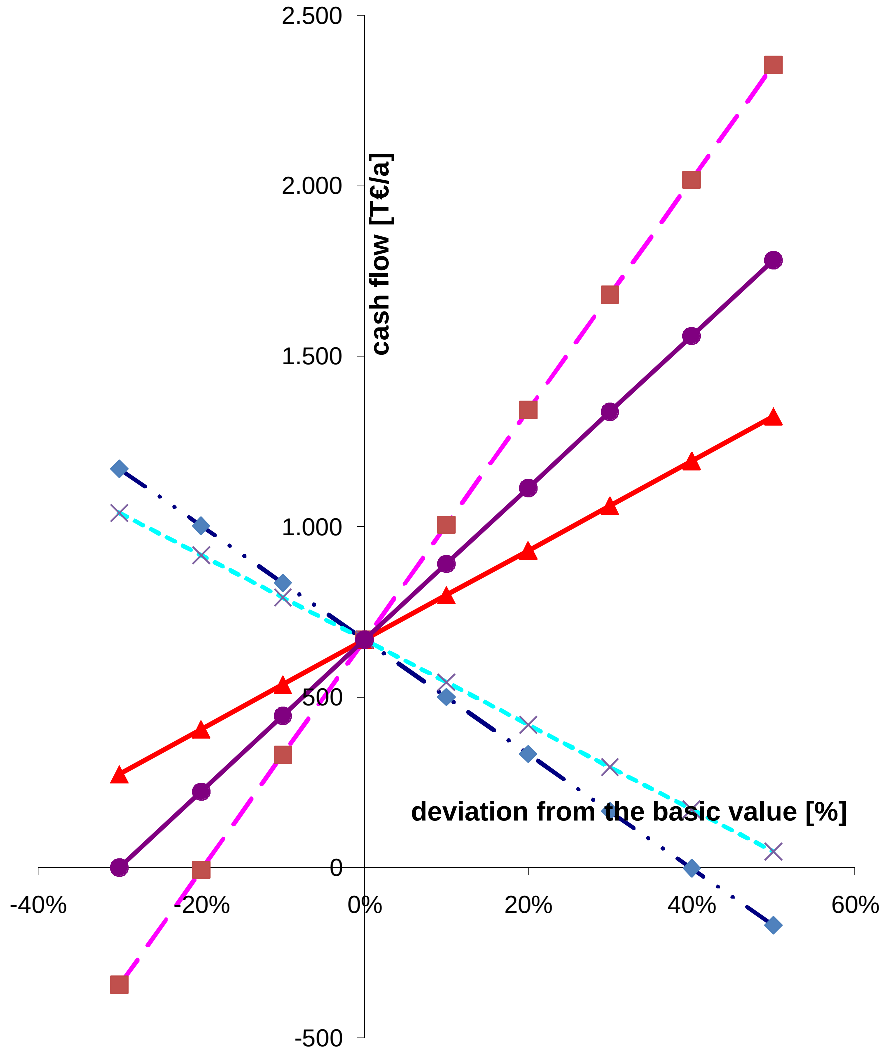


B. sensitivity analysis

cash flow after debt service (loan capi **668 T€/a** (basic value)

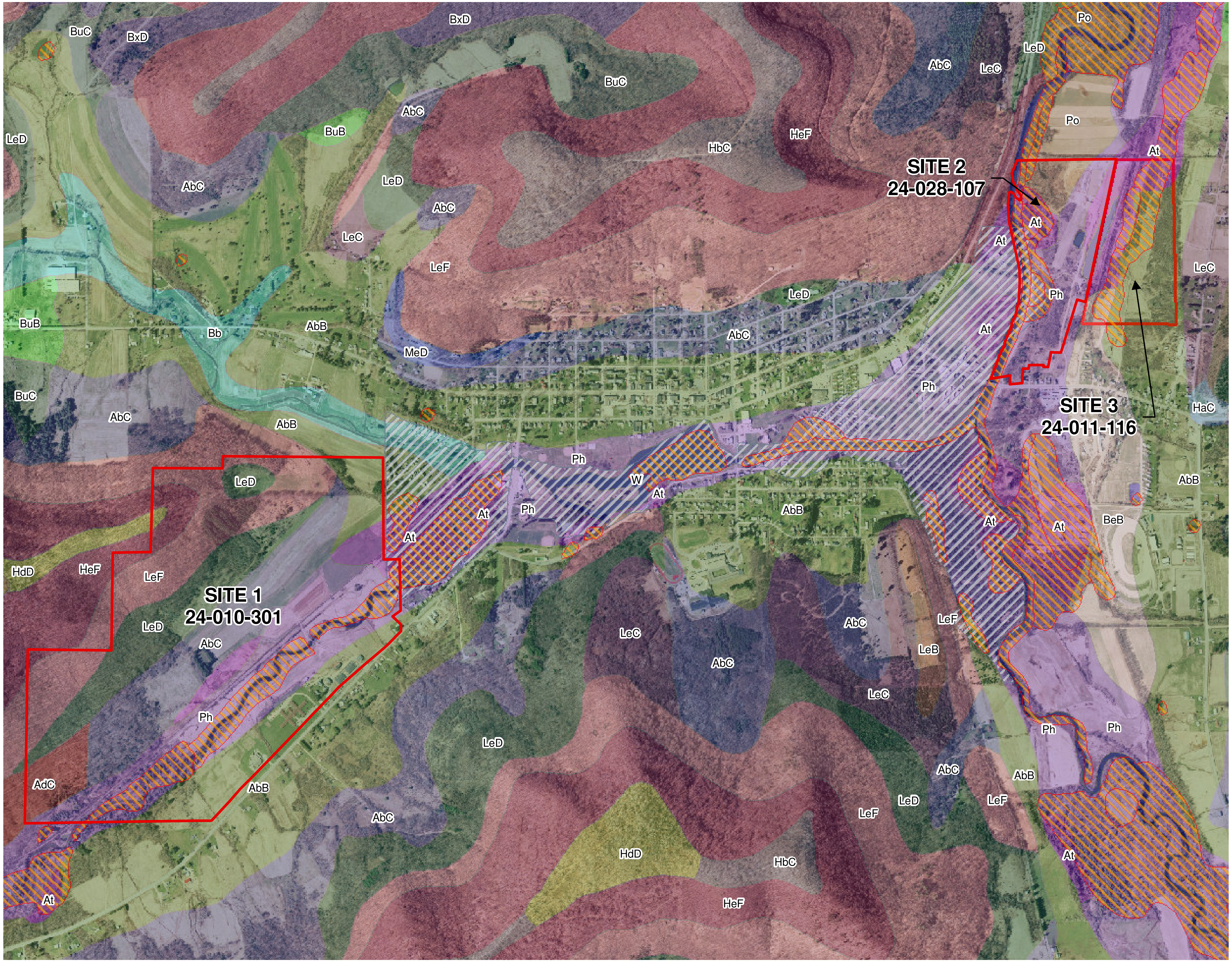
output parameter	unit	value ∅	productivity in full load hours -30%	-20%	-10%	0%	10%	20%	30%	40%	50%
conditions of fuel purchase	€/MWh	23,33	1.170	1.003	835	668	500	333	166	-2	-169
power production	TMWh/a	39	-344	-7	330	668	1.005	1.343	1.680	2.017	2.355
specific sales terms of heat	€/MWh	40,10	274	405	537	668	799	930	1.061	1.193	1.324
costs of capital	€/a	1.240	1.040	916	792	668	544	420	296	172	48
productivity in full load hours	h/a	8.000	-1	222	445	668	891	1.113	1.336	1.559	1.782

Sensitivity of the cash flow to the deviation of single parameters



The steeper the gradient of one single parameter, no matter if positive or negative, the more sensitive is the considered parameter to a deviation from the basic value.

Annex IV.A.4



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NAME: NewtonJM

DATE: 11/16/2009 9:51:34 AM

FIGURE 1.1

N

Legend

- SITE BOUNDARIES
- NATIONAL WETLAND INVENTORY
- 100-YR FEMA FLOOD ZONE

NOTE: 100-YR FEMA FLOOD ZONE BOUNDARY IS AN APPROXIMATION BASED OF A 1978 FLOOD INSURANCE RATE MAP AND IS LIKELY INCOMPLETE.

LAHMEYER INTERNATIONAL GmbH
SMETHPORT, PENNSYLVANIA

SITE LOCATION

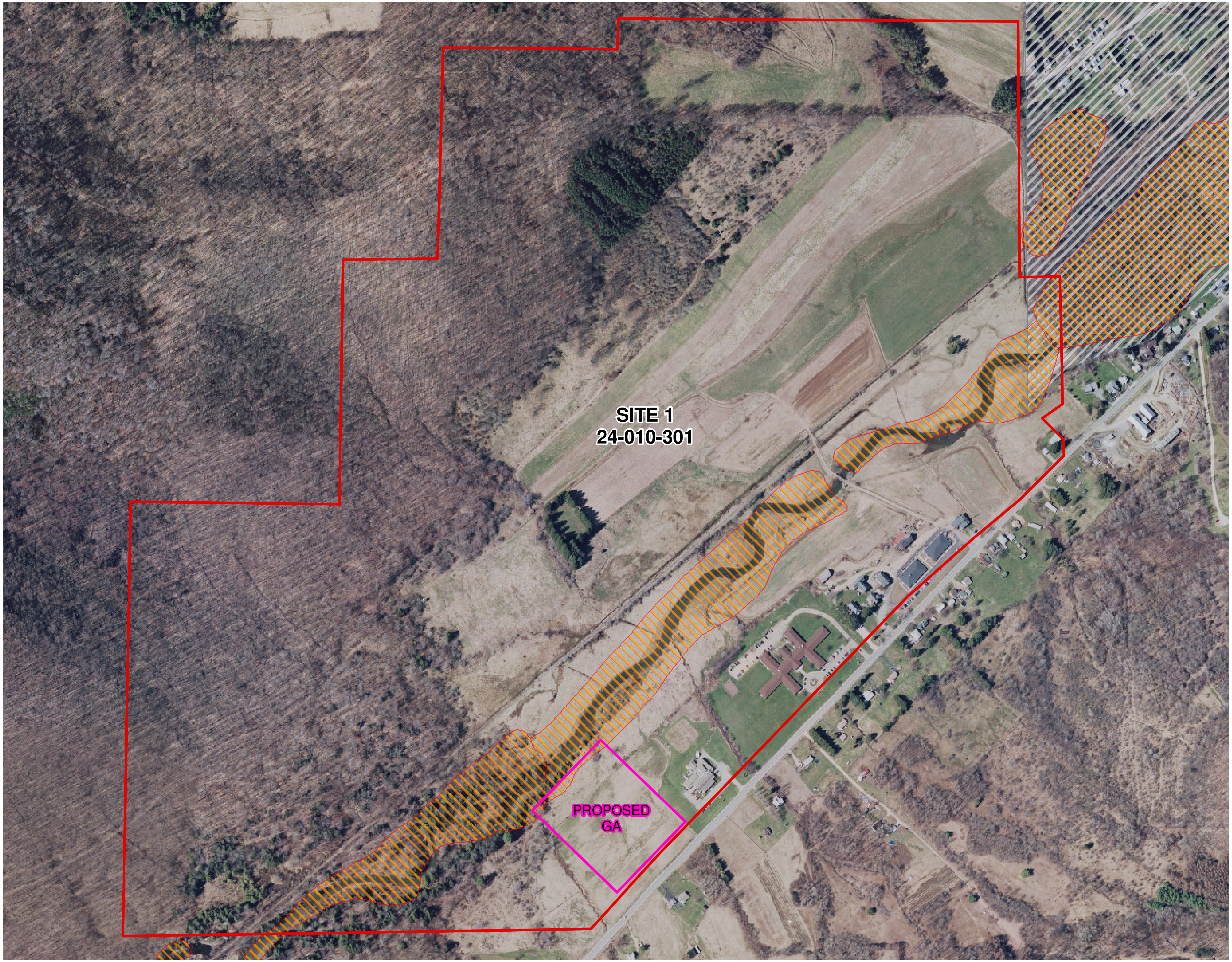
0 625 1,250 2,500
Feet

NOVEMBER 2009
14604.45072

O'BRIEN & GERE

FIGURE 1.2

N



This document was developed in color. Reproduction in B/W may not represent the data as intended.

Legend

- SITE BOUNDARIES
- NATIONAL WETLAND INVENTORY
- 100-YR FEMA FLOOD ZONE

NOTE: 100-YR FEMA FLOOD ZONE BOUNDARY IS AN APPROXIMATION BASED OF A 1978 FLOOD INSURANCE RATE MAP AND IS LIKELY INCOMPLETE.

LAHMEYER
INTERNATIONAL GmbH
SMETHPORT, PENNSYLVANIA

SITE 1

0 250 500 1,000
Feet

NOVEMBER 2009
14604.45072

O'BRIEN & GERE

PATH: I:\Lahmeyer-Int-L.14604\45072.Distric-Heating\Docs\DWG\MXD\SITE1_Enviro.mxd

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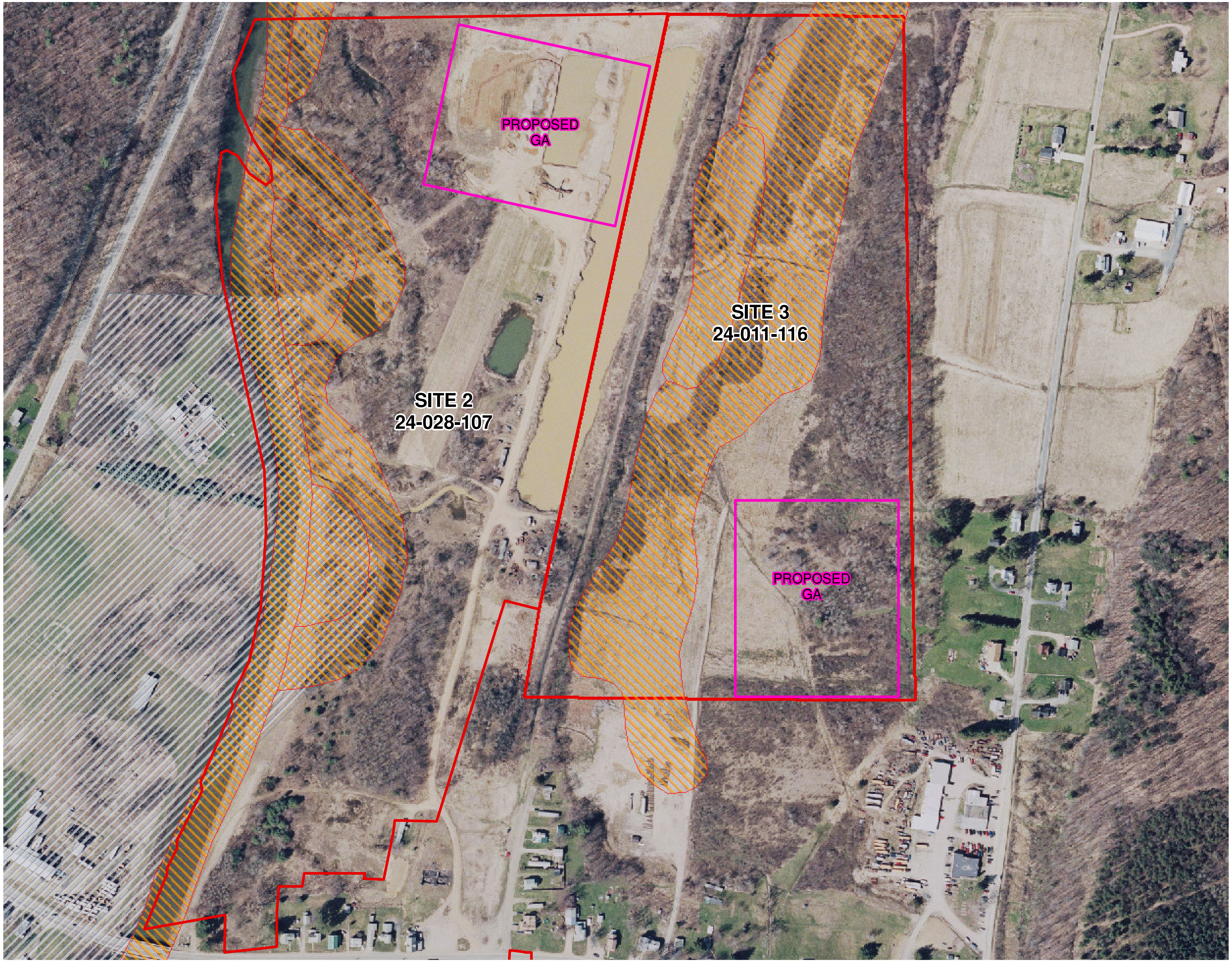

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FIGURE 1.3

N

Legend

- SITE BOUNDARIES
- NATIONAL WETLAND INVENTORY
- 100-YR FEMA FLOOD ZONE

NOTE: 100-YR FEMA FLOOD ZONE BOUNDARY IS AN APPROXIMATION BASED OF A 1978 FLOOD INSURANCE RATE MAP AND IS LIKELY INCOMPLETE.

LAHMEYER
INTERNATIONAL GmbH
SMETHPORT, PENNSYLVANIA

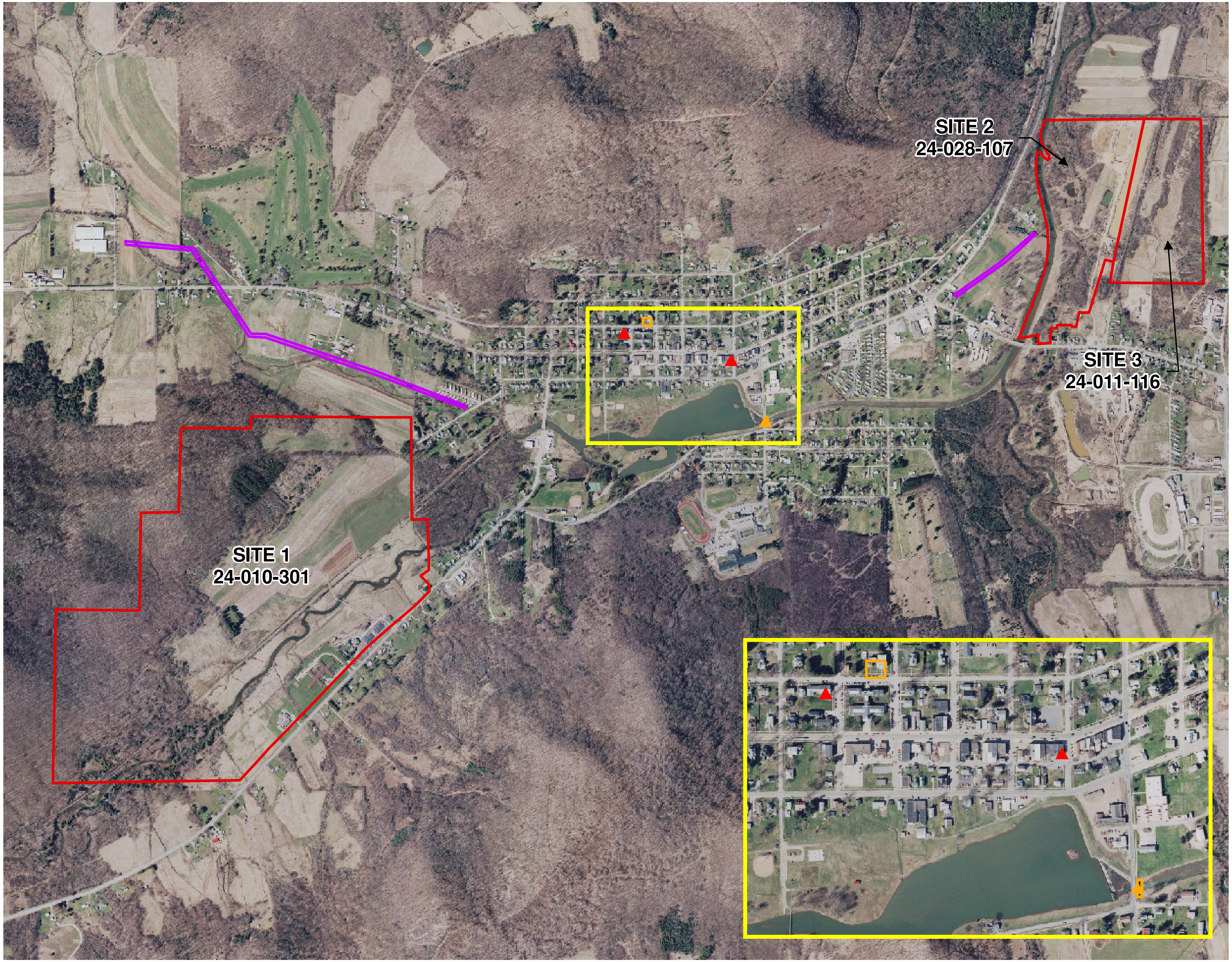
SITE 2 AND 3

0 150 300 600
Feet

NOVEMBER 2009
14604.45072

O'BRIEN & GERE

FIGURE 1.4



N

Legend

- ARCHAEOLOGICAL SURVEY
- NHL ELIGIBLE
- NHL ELIGIBLE
- NHL INELIGIBLE
- Smethport_Portion_of_Keating_Parcel

LAHMEYER
INTERNATIONAL GmbH
SMETHPORT, PENNSYLVANIA

HISTORIC AND ARCHAEOLOGICAL SITES

0 625 1,250 2,500
Feet

NOVEMBER 2009
14604.45072

O'BRIEN & GERE

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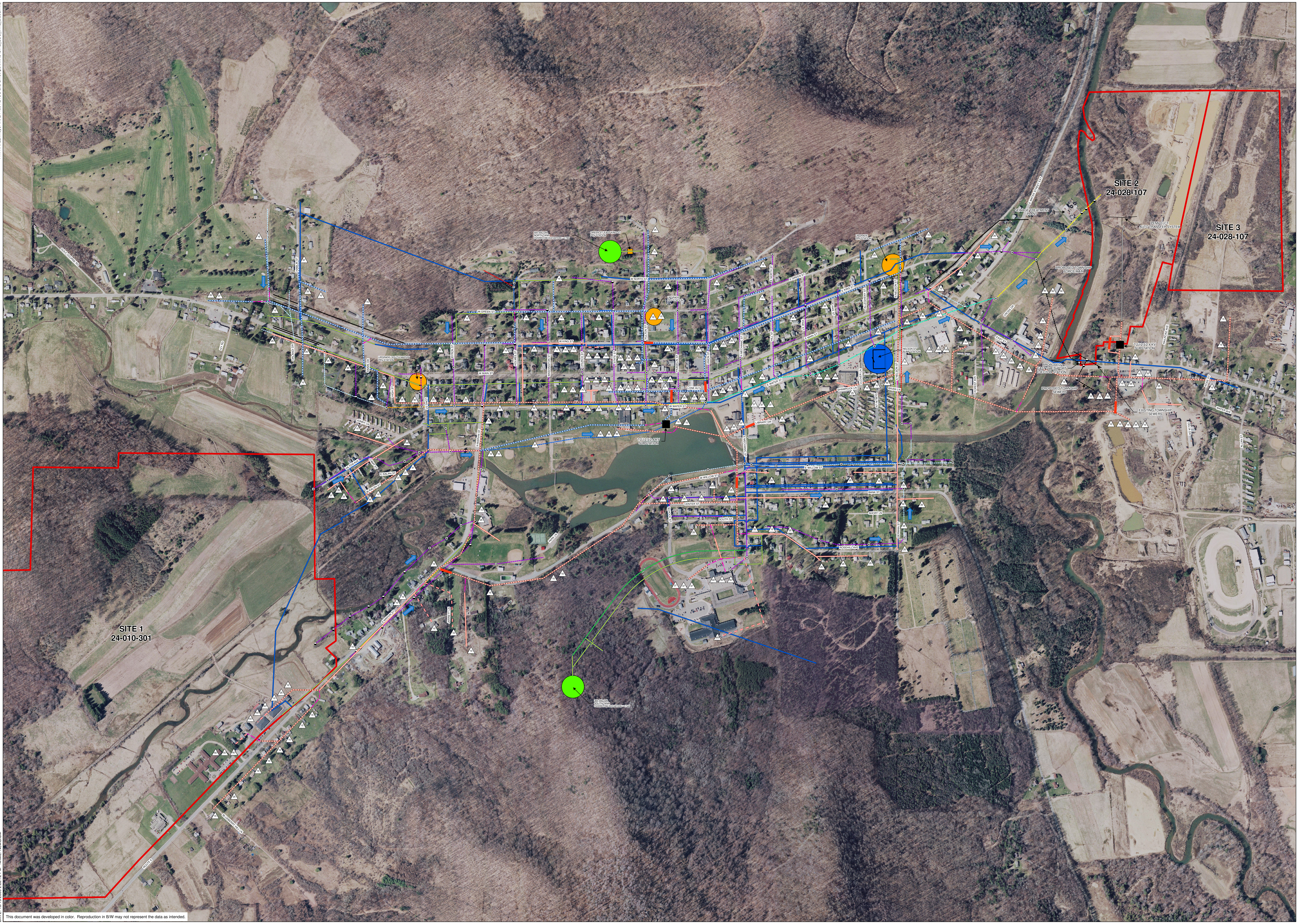
NAME: NewtonJM

DATE: 11/16/2009 10:08:56 AM



LEGEND

- SITE BOUNDARIES
- MANHOLE RAISED TO GROUND LEVEL AND ACCESSABLE
- MANHOLE COVERED BY STREET
- SEWAGE FLOW DIRECTION

SEWER SYSTEM DIAMETER (INCHES)

- 18
- 15
- 12
- 10
- 8
- 6
- 4
- UNKNOWN

WATER MAINS

- 12" WATER MAIN
- 8" WATER MAIN
- 6" WATER MAIN
- UNKNOWN

TANK/STATIONS

- PRV STATION
- PUMP STATION
- TANK

ELECTRICAL DISTRIBUTION

- PENN ELECT. AUTO TRANSFER SYSTEM
- PENN ELECT 12.5 KV
- 2.4 KV Δ LINES (AERIAL)
- 3 Θ LINE
- 7.2/12.47 KV GND Y LINES (AERIAL)
- 7.2/12.47 KV GND Y LINES (UNDERGROUND)
- DISCONNECT
- FUSE

- TRANSFORMER
- 3 Θ RECLOSER 140A SERIES COILS
- 3-333 SUBSTATION

LAHMEYER
INTERNATIONAL GmbH
SMETHPORT, PENNSYLVANIA

N

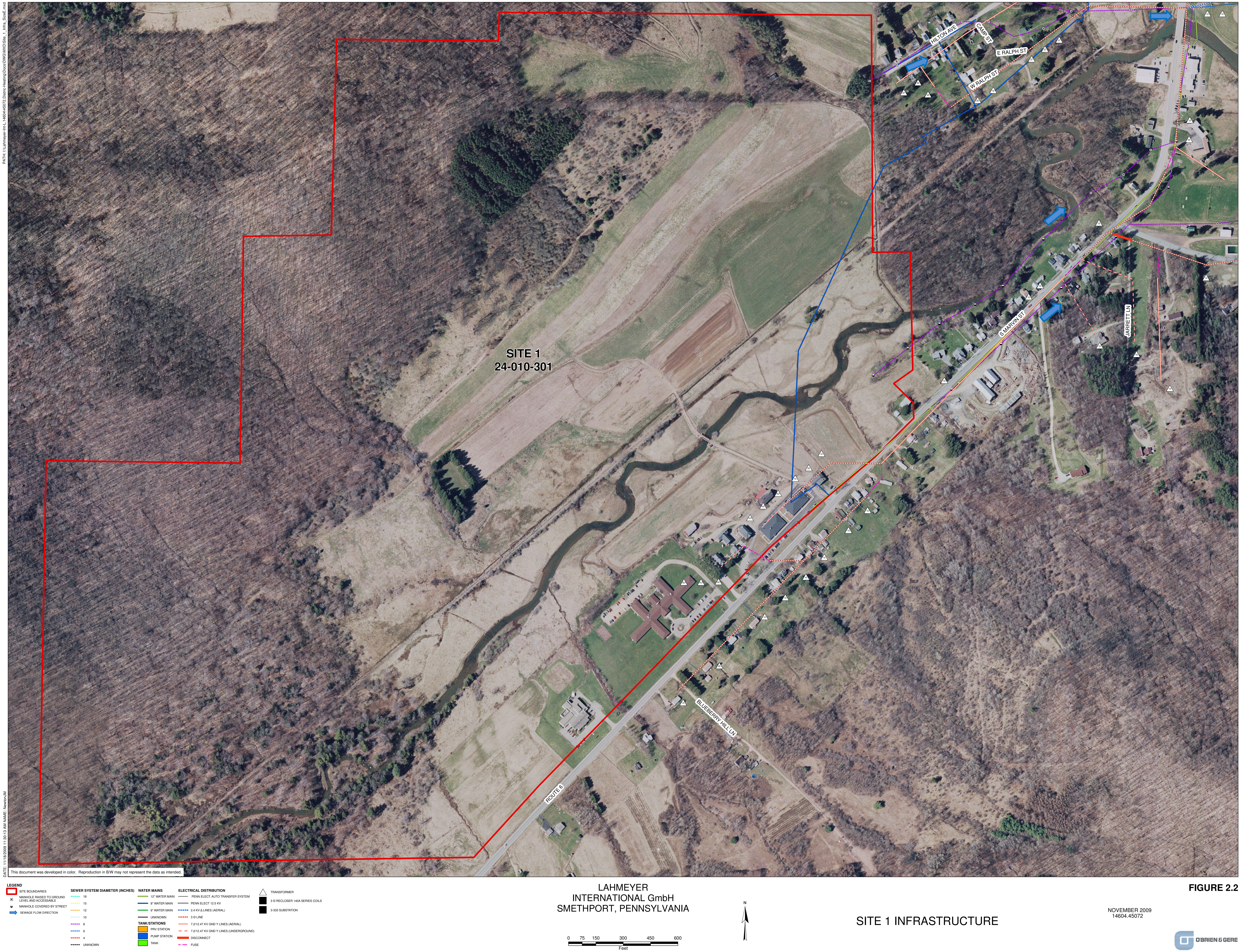
0 150 300 600 900 1,200
Feet

FIGURE 2.1

SITE INFRASTRUCTURE

NOVEMBER 2009
14604.45072

O'BRIEN & GERE



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SITE 1 INFRASTRUCTURE

FIGURE 2.2

NOVEMBER 2009
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LAHMEYER
INTERNATIONAL GmbH
SMETHPORT, PENNSYLVANIA

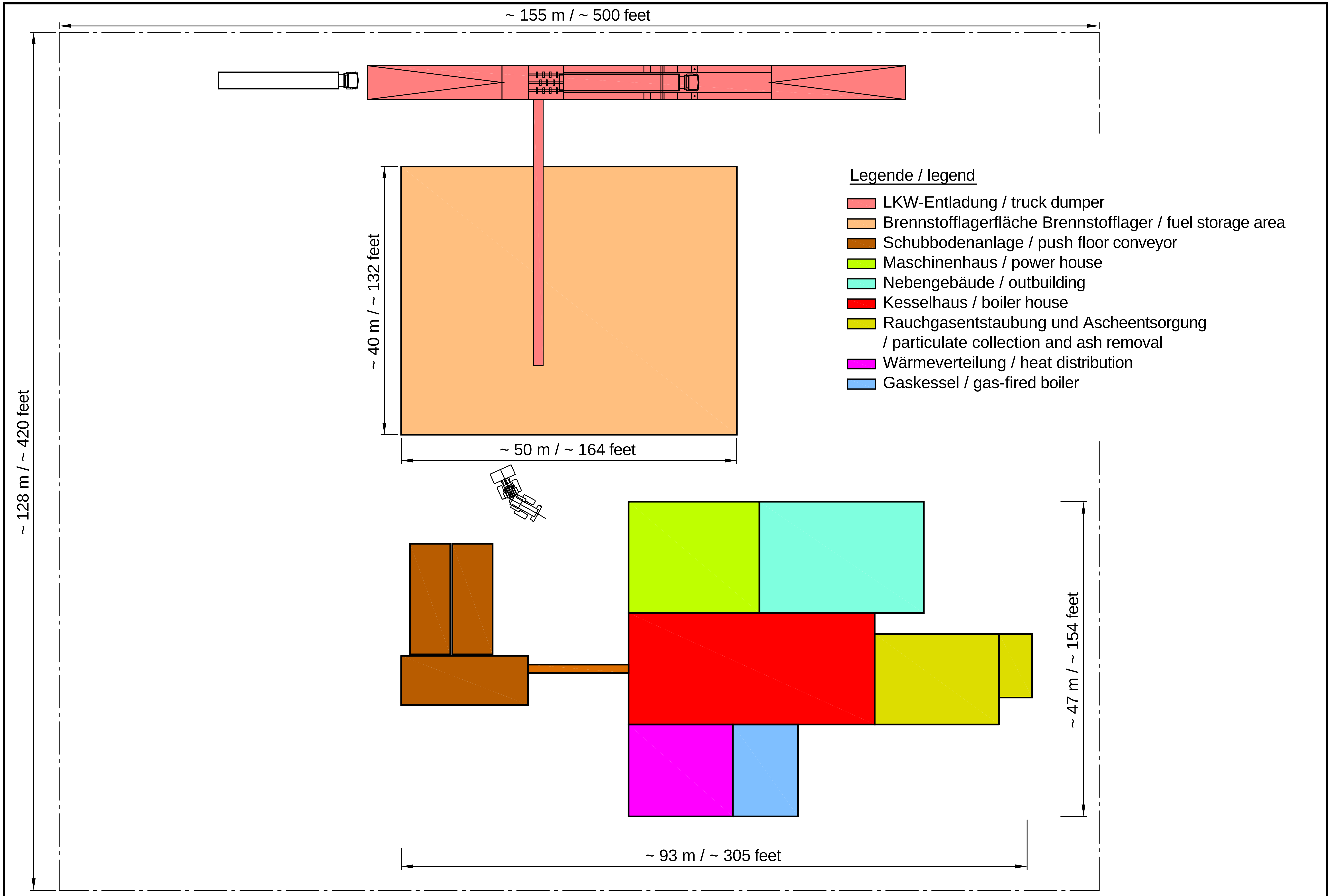
FIGURE 2.3

SITE 2 AND 3 INFRASTRUCTURE

NOVEMBER 2009
14604.45072

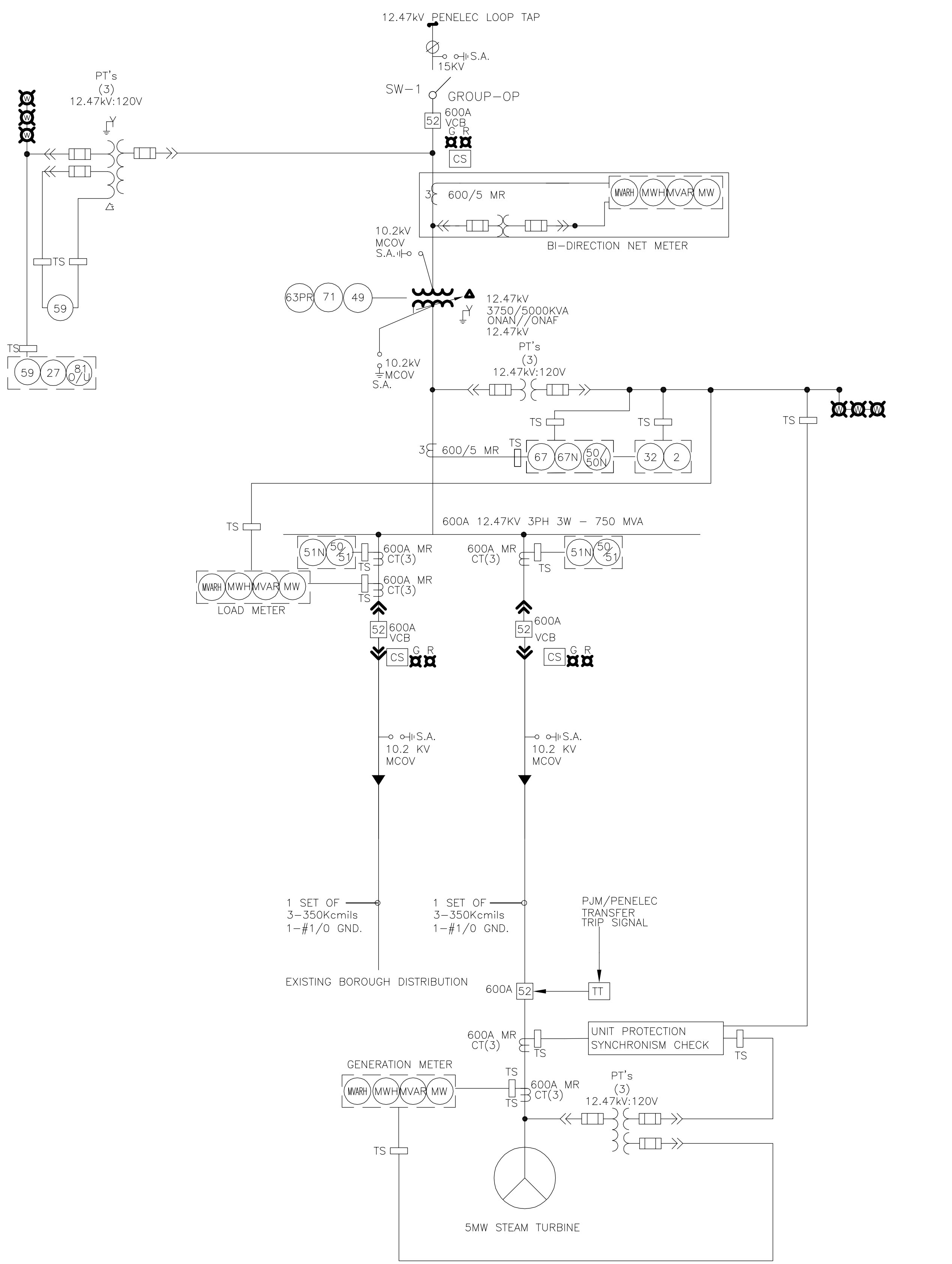
O'BRIEN & GERE

Annex IV.A.5



Hinweis:	Planverfasser:	Maßstab:	Benennung:	Kunde:
Alle Maße und techn. Angaben sind verantwortlich durch den Auftragnehmer zu prüfen. Es gilt der Schutzvermerk nach DIN 34.	SEEGER ENGINEERING – ENERGIE- UND UMWELTTECHNIK	1:500	Layout Alternative 3 Smethport (PA), USA	Lahmeyer International
		Gezeichnet: Prinz / Datum: 04.11.2009		Stand: 04.11.2009 / Zeichnungs-Nr.: 1260-03-P

FIGURE 2



LEGEND

49	TRANSFORMER THERMAL RELAY
71	LIQUID LEVEL RELAY
63PR	LIQUID PRESSURE RISE RELAY
50/51	INSTANTANEOUS OVERCURRENT AND AC TIME OVERCURRENT RELAY
50N/51N	GROUND INSTANTANEOUS OVERCURRENT AND AC TIME OVERCURRENT RELAY
63	LIQUID PRESSURE RELAY
27	UNDERVOLTAGE RELAY
59	OVERVOLTAGE RELAY
25	SYNCHRONIZING CHECK DEVICE
67	DIRECTIONAL OVERCURRENT AND AC TIME OVERCURRENT RELAY
51N	GROUND AC TIME RELAY
67N	DIRECTIONAL OVERCURRENT AND AC TIME OVERCURRENT RELAY
W	WHITE LIGHT
R G CS	CONTROL SWITCH WITH RED, GREEN LIGHTS
S.A.	LIGHTNING ARRESTER
S.A.	SURGE ARRESTER
	UNDERGROUND CONDUCTORS
600/5 MR	600/5 MR 2000:5 MULTI-RATIO CURRENT TRANSFORME
TS	RELAY FT-1 SWITCH
52	BREAKER
25	MULTIFUNCTION ELECTRONIC PROTECTION RELAY. (ANSI TAGS INDICATE PROTECTIVE FEATURES)

LAHMEYER
INTERNATIONAL GmbH
SMETHPORT, PENNSYLVANIA

CoGENERATION ONE-LINE DIAGRAM

NOVEMBER 2009
14604.45072

O'BRIEN & GERE

Annex IV.A.5

Construction

		Quantity	Units		Unit Cost		Cost ($ - USD)
3	**Civil Engineering**						
A	Site clearing	6,00	acres	$	13.000,00	$	78.000,00
B	Road Development	200,00	feet	$	400,00	$	80.000,00
C	Paving	40.000,00	sf	$	8,00	$	320.000,00
D	Landscaping	1,00	acre	$	45.000,00	$	45.000,00
E	Site development, site lighting, rough grade, excavations	6,00	acres	$	17.000,00	$	102.000,00
F	Misc general conditions and mobilization/fees	1,00	each	$	250.000,00	$	250.000,00
G	Fencing	2.000,00	feet	$	25,00	$	50.000,00
	Utilities						
G	Water piping to building (8")	200,00	feet	$	225,00	$	45.000,00
H	WW Piping (12")	200,00	feet	$	175,00	$	35.000,00
I	Natural gas piping (4")	200,00	feet	$	175,00	$	35.000,00
J	Electrical interconnection/transformers	1,00	each	$	485.360,00	$	485.360,00
K	Storm water system	1,00	each	$	250.000,00	$	250.000,00
						$	-
					Sub-Totals	$	1.775.360,00
L	O'Brien & Gere Design and Construction Management Services (10% of construction costs)					$	177.536,00
M	Contingency Allowance (10% of construction costs)					$	177.536,00
					Totals	**$**	**2.130.432,00**

Annex IV.A.6-A

Potential Right-to-Build Permits, Approvals and Reviews

SMETHPORT, PA DISTRICT HEATING
POTENTIAL RIGHT-TO-BUILD PERMITS, APPROVALS & REVIEWS

	Permit	Activity	Agency	Regulatory Review Timeframes	Site Applicability ✓ = Applicable Permit/Review A = Activity-Specific S = Site-Specific		
					Site 1	Site 2	Site 3
	Federal						
1	Section 404 of the Clean Water Act (Joint Application)	Work within waters of the United States (including non-isolated wetlands; delineation required for application). Nationwide Permits vs. Project-Specific Permit.	USACE	180-days (Pre-Construction)		✓(S)	
2	National Environmental Policy Act (NEPA)	Environmental impact assessment of federally-approved and/or funded programs.	Multiple (funding)	Coordinated with federal reviewing agency.	✓(A/S)	✓(A/S)	✓(A/S)
	Commonwealth						
3	Section 401 of the Clean Water Act (401 Water Quality Certification)	Certification is used to ensure that federal agencies issuing permits or carrying out direct actions, which may result in a discharge to waters of the United States do not violate Commonwealth water quality standards or impair designated uses.	PADEP	Concurrent with other PADEP permit processing, and in conjunction with issuance of federal permit.		✓(S)	
4	Water Obstruction & Encroachment General Permits or Project Specific Permit or Environmental Assessments for Waived Activities for Water Obstruction & Encroachment (25 PA Code Chapters 105, 106)	Persons planning to construct, operate, maintain, or enlarge any water obstruction or encroachment that will affect a waterway, its 100-year floodway or any lake, pond, reservoir, or wetland must obtain a PADEP permit. (Includes work within 50-feet of a stream, waterway or wetland.) Activities located on submerged lands of the Commonwealth will also require a Submerged Lands License Agreement. Wetland replacement may be required. (See also USACE Section 404 Permit requirements.)	Local County Conservation District or PADEP (Regional Solis & Waterways Section)	General Permit Administrative Completeness – 20-days Response to Deficiency Letter – 30-days Technical Review 1 – 40-days Technical Review 2 (if needed) – 0-days Final Decision – 0-days Written Public Comment Period – Act 14 Municipal Notification. Project Specific Permit or EA Administrative Completeness – 20-days Response to Deficiency Letter – 30-days Technical Review 1 – 60-days Technical Review 2 (if needed) – 25-days Final Decision – 25-days Written Public Comment Period – Act 14 Municipal Notification.		✓(S)	

O'BRIEN & GERE

	Permit	Activity	Agency	Regulatory Review Timeframes	Site Applicability ✓ = Applicable Permit/Review A = Activity-Specific S = Site-Specific		
					Site 1	Site 2	Site 3
5	Air Quality Plan Approval/Operating Permit (Title V or State Only Permit) (25 PA Code 127)	Permit to construct and operate an air emission source.	PADEP (Regional Air Quality Program)	90 to 180-days (Pre-Construction)	✓(A)	✓(A)	✓(A)
6	Storage Tank Registration & Permitting (25 PA Code Chapter 245)	Anyone wishing to operate a new or existing regulated storage tank must register that tank with PADEP prior to operating the tank. Once a storage tank is registered, the tank is deemed to be permitted, unless the applicant is notified otherwise by the Department, with either a Permit-By-Rule or a General Permit (including construction-related). May require site-specific installation permit. SPR and/or SPCC Plan may be necessary depending upon quantities.	PADEP (Division of Storage Tanks)	Administrative Completeness – 20-days Response to Deficiency Letter – 30-days Technical Review 1 – 70-days Technical Review 2 (if needed) – 0-days Final Decision – 0-days Written Public Comment Period – Not Applicable	✓(A)	✓(A)	✓(A)
7	NPDES Individual Permit for Storm Water Discharges Associated With Construction Activities or NPDES General Permit (PAG-02) or Erosion & Sediment Control Permit (25 PA Code Chapters 92, 93, 102)	Storm water discharges from construction phase activities disturbing five-acre or greater. Requires development, implementation and maintenance of erosion control measures and facilities that are set forth in an erosion and sedimentation control plan.	Local County Conservation District or PADEP (Regional Soils & Waterways Section)	Administrative Completeness – 20-days Response to Deficiency Letter – 30-days Technical Review 1 – 66-days Technical Review 2 (if needed) – 32-days Final Decision – 32-days Written Public Comment Period – Requires municipal notification.	✓(A)	✓(A)	✓(A)
8	NPDES General Permit (PAG-03) for Discharge of Storm Water Associated With Industrial Activities (25 PA Code Chapters 91 – 105)	Discharge of storm water from new or existing point sources associated with industrial activities.	PADEP (Regional Water Quality Permitting Section)	Administrative Completeness – 20-days Response to Deficiency Letter – 30-days Technical Review 1 – 60-days Technical Review 2 (if needed) – 0-days Final Decision – 0-days Written Public Comment Period – Public	✓(A)	✓(A)	✓(A)

	Permit	Activity	Agency	Regulatory Review Timeframes	Site Applicability ✓ = Applicable Permit/Review A = Activity-Specific S = Site-Specific		
					Site 1	Site 2	Site 3
				notice of every final action is published by PADEP in *Pennsylvania Bulletin*.			
9	NPDES New and Existing Sewage Discharger, Short Form; NPDES Part I Permit (25 PA Code Chapters 91 – 105)	Discharge of industrial wastewater and storm water to surface waters (dry swale, rivers, streams, lakes), ground water, or an existing sanitary sewer system or storm water system.	PADEP (Regional Water Quality Permitting Section)	Administrative Completeness – 20-days Response to Deficiency Letter – 30-days Technical Review 1 – 60-days Technical Review 2 (if needed) – 30-days Final Decision – 90-days Written Public Comment Period – Required municipal notification. Public notice of every final action is published by PADEP in *Pennsylvania Bulletin*.	✓(A)	✓(A)	✓(A)
10	Act 537 Sewage Facilities Planning (25 PA Code Chapter 71)	Approval of wastewater facility designs (including pre-treatment facility); discharges to sanitary sewer.	Local Municipality; County Planning Agency; County Health Dept.; PADEP (Regional Water Quality Permitting Section)	Administrative Completeness – 14-days Technical Review 1 – 30-days Technical Review 2 (if needed) – 0-days Final Decision – 0-days Written Public Comment Period – Not Applicable	✓(A)	✓(A)	✓(A)
11	Residual Waste General Permits Beneficial Use	Residual waste general permits may be issued on a regional or statewide basis for a category of processing and/or beneficial use of residual waste. Wastes must be similar physically and chemically and must be used and processed in a similar fashion. Persons may be authorized to operate under an existing general permit via a registration or determination of applicability.	PADEP Bureau of Waste Management	Administrative Completeness – 0-days Technical Review 1 – 30-60-days Technical Review 2 (if needed) – 0-days Final Decision – 0-days	✓(A)	✓(A)	✓(A)
12	Environmental Assessment (PA Code § 271.127)	Environmental assessment in a permit application shall include at a minimum a detailed analysis of	PADEP	Concurrent with PADEP permit review process.	✓(A/S)	✓(A/S)	✓(A/S)

O'BRIEN & GERE

	Permit	Activity	Agency	Regulatory Review Timeframes	Site Applicability ✓ = Applicable Permit/Review A = Activity-Specific S = Site-Specific		
					Site 1	Site 2	Site 3
		the potential impact of the proposed facility on the environment, public health and public safety, including traffic, aesthetics, air quality, water quality, stream flow, fish and wildlife, plants, aquatic habitat, threatened or endangered species, water uses, land use and municipal waste plans. The applicant shall consider features such as scenic rivers, recreational river corridors, local parks, State and Federal forests and parks, the Appalachian Trail, historic and archaeological sites, National wildlife refuges, State natural areas, National landmarks, farmland, wetland, special protection watersheds designated under Chapter 93 (relating to water quality standards), airports, public water supplies and other features deemed appropriate by the Department or the applicant. The permit application shall also include all correspondence received by the applicant from any State or Federal agency contacted as part of the environmental assessment. Federal funding/permits may require NEPA review.					

O'BRIEN & GERE

	Permit	Activity	Agency	Regulatory Review Timeframes	Site Applicability ✓ = Applicable Permit/Review A = Activity-Specific S = Site-Specific		
					Site 1	Site 2	Site 3
13	PA Historical & Museum Commission (PHMC) Cultural Resource Notice	Unless exempt as specified in the PADEP PHMC Policy "List of Exemptions", if more than 10 acres are disturbed, it is the applicant's responsibility to notify the PA Historical & Museum Commission – Bureau of Historic Preservation to assess potential impacts on significant historical and archaeological resources.	PA Historical & Museum Commission – Bureau of Historic Preservation	Concurrent with PADEP permit review process.	✓(A/S)	✓(A/S)	✓(A/S)
14	PA Natural Diversity Inventory (PNDI)	Coordination effort to facilitate avoidance and minimization of impacts to endangered and threatened and special concern species and resources, *etc.* in the Commonwealth of Pennsylvania.	PADEP	Concurrent with PADEP permit review process.	✓(S)	✓(S)	✓(S)
15	Highway Work Permit	Work within highway rights-of-way (highway and utility improvements), including driveway cuts.	Highway Jurisdiction	30 to 90-days (Pre-Construction)	✓(S)	✓(S)	✓(S)
	Local						
16	Floodplain Development Permit	Work within 100-year floodplain.	Local County Conservation District or PADEP (Regional Soils & Waterways Section)	[ ] (Pre-Construction)		✓(S)	
17	Rezone	Rezone to allow proposed land use (if necessary) (See also PA Land Use Policy)	Municipal Board	30 to 90-days (3 meetings or < - typical) (Pre-Construction)	[ ](A)	[ ](A)	[ ](A)
18	Site Plan Approval	Approval of site modifications. (May not be necessary if no major site modifications [*i.e.*, Building Permit only] – coordinate with municipal Code Enforcement Officer to identify process). (See also PA Land Use	Municipal Planning Board	120-days (typical) 3 meetings (typical) – Sketch Plan, Preliminary Plan, Final Plan (Pre-Construction)	✓(A)	✓(A)	✓(A)

	Permit	Activity	Agency	Regulatory Review Timeframes	Site Applicability ✓ = Applicable Permit/Review A = Activity-Specific S = Site-Specific		
					Site 1	Site 2	Site 3
		Policy)					
19	Subdivision Approval	Consolidation or breakout of parcels.(See also PA Land Use Policy)	Municipal Planning Board	30 to 90-days (3 meetings or < - typical) (Pre-Construction)	✓(A)	✓(A)	See Note 14
20	Variances	Approval of area (*i.e.*, encroachment on setbacks) and/or use variances.	Municipality (ZBA)	1 or 2 meetings (typical) (Pre-Construction)	[ ](A/S)	[ ](A/S)	[ ](A/S)
21	Industrial Wastewater Discharge Permit (Local Sewer Use Ordinance & Federal Pretreatment Regulations)	Approval of additional sanitary and process waste discharges to POTW. Also includes approval of pre-treatment program.	Municipality, USEPA	Coordinated with POTW.	[ ](A)	[ ](A)	[ ](A)
22	Building Permit	Building code compliance.	Local Code Enforcement Office	Coordinated with local code enforcement officer/building inspector.	✓(A)	✓(A)	✓(A)
23	Certificate of Occupancy	Approval to occupy building.	Local Code Enforcement Office	Coordinated with local code enforcement officer/building inspector.	✓(A)	✓(A)	✓(A)

Acronyms
EA – Environmental Assessment
GP – General Permit
NEPA – National Environmental Policy Act
NPDES – National Pollutant Discharge Elimination System
PA – Pennsylvania
PADEP – Pennsylvania Department of Environmental Protection
PNDI – Pennsylvania Natural Diversity Inventory
PHMC – Pennsylvania Historic and Museum Commission
POTW – Publicly-Owned Treatment Works
SPCC – Spill Prevention, Control and Countermeasure
SPR – Spill Prevention Report
SWPPP – Storm Water Pollution Prevention Plan
USACE – United States Army Corps of Engineers
USEPA – United States Environmental Protection Agency
ZBA – Zoning Board of Appeals

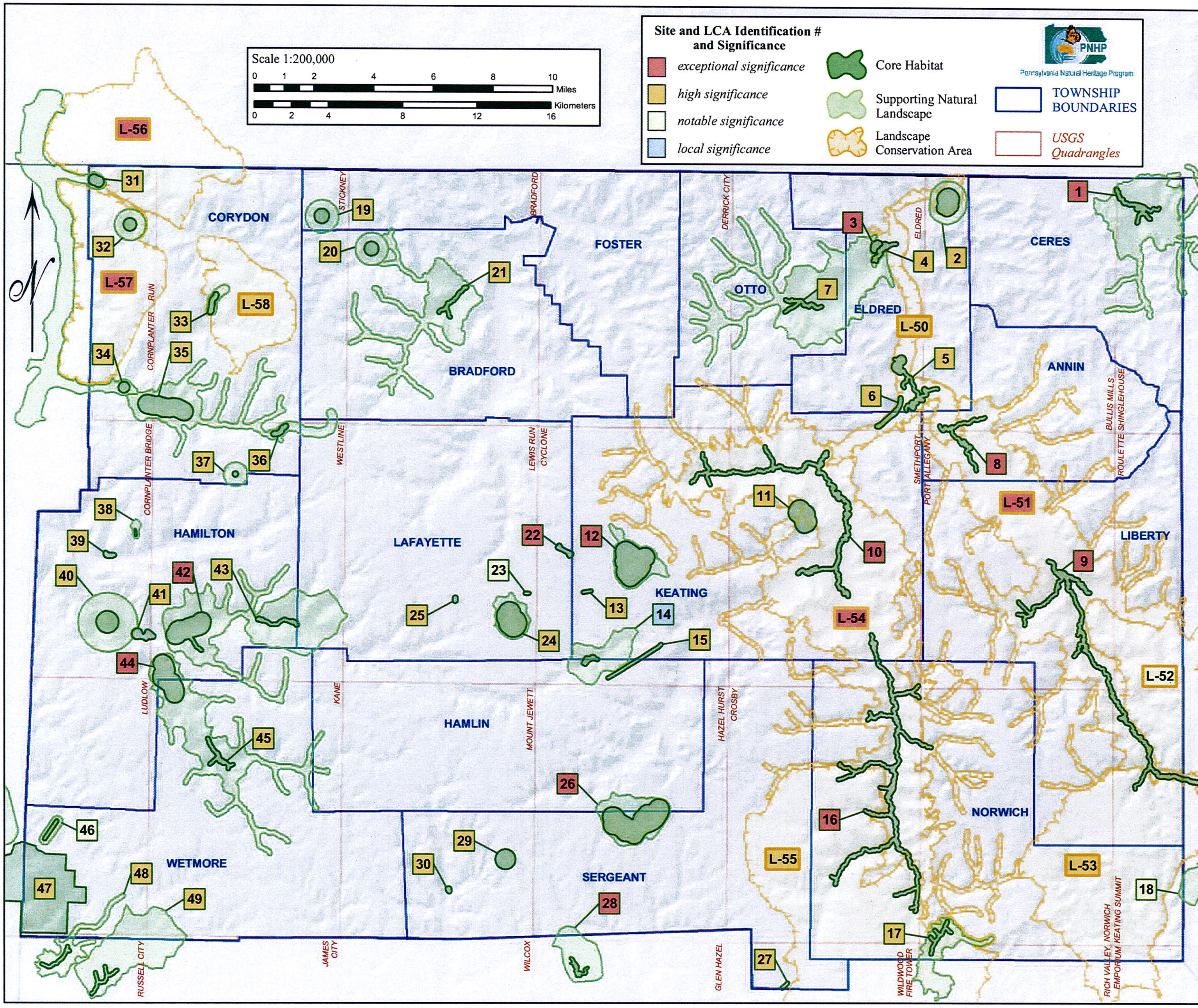
Notes/Assumptions
1. Typical timeframes (actual timeframes may differ).
2. Source: Guide to DEP Permits & Other Authorizations (http://www.elibrary.dep.state.pa.us/dsweb/Get/Document-66255/4000-BK-DEP0341.pdf).

3. Adequate water supply; sewer and POTW capacity; wastewater discharges to POTW (vs. environment).
4. Use of greenfield sites.
5. Public notice of every final action is published by PADEP in *Pennsylvania Bulletin*.
6. Municipal notification refers to Act 14 requirements.
7. Policy for Consideration of Local Comprehensive Plans and Zoning Ordinances in DEP Review of Permits for Facilities and Infrastructure (*i.e.*, Land Use Policy)
8. Policy for Pennsylvania Natural Diversity Inventory (PNDI) Coordination during Permit Review and Evaluation (*i.e.*, PNDI Policy)
9. Implementation of the Pennsylvania State History Code: Policy and Procedures for Applicants for DEP Permits and Plans Approvals' Policy (*i.e.*, PHMC Policy)
10. Permit Coordination Policy
11. Environmental Justice issues may apply.
12. Project is not located within Susquehanna River Basin and does not require consultation with Susquehanna River Basin Commission (*i.e.*, Consumptive Water Use).
13. PADEP application packages may include: General Information Form (GIF), Program Specific Authorization Application Forms, Cultural Resource Notice, Environmental Assessment, and other required documents.
14. Site No. 3 does not meet the minimum specified size requirement. Site Nos. 1 and 2 are larger than the specified minimum size, and may be subdivided to create a sufficient developable parcel.

Annex IV.A.6-B

Natural Heritage Sites

McKean County Natural Heritage Inventory Site Index



#	Conservation Area Name	#	Conservation Area Name
1	Oswayo Creek	31	Willow Bay
2	Bullis Mills	32	Coffey Run
3	Indian Crossing Swamp	33	Whitney Run
4	Lower Knapp Creek	34	Sugar Bay
5	Allegheny River at Larabee	35	Sugar Run Mouth
6	Coryville Railroad Grade	36	Sugar Run
7	Upper Knapp Creek	37	Klondike Upland
8	Allegheny River at Turtlepoint	38	Briggs Run
9	Allegheny Portage Creek	39	Chappel Bay
10	Potato Creek – Cole Creek	40	Kiasutha Campground
11	Smethport Upland	41	Red Bridge
12	Ormsby Swamp	42	Kinzua Creek
13	Route 59 Roadside	43	Kinzua Creek below Westline
14	Kinzua Gorge	44	Swede Hill
15	Kasson Railroad Grade	45	South Branch Kinzua Creek
16	Potato Creek	46	Pigeon Run Headwater
17	Havens Run	47	Tionesta Natural Areas
18	Keating Summit	48	Crane Run
19	Cobb Hollow Upland	49	Martin Run
20	Brown Valley	**#**	**Landscape Conservation Area**
21	West Branch Tunungwant Creek	L-50	Allegheny Wetland Complex
22	Bingham	L-51	Upper Allegheny River
23	Mount Alton Roadside	L-52	Lookout Mountain
24	Mount Alton Wetland	L-53	Keating Summit
25	Pine Run Roadside	L-54	Potato Creek
26	Cathrine Swamp	L-55	Elk River
27	Elk State Forest	L-56	State Line
28	Midmont Swamp	L-57	Tracy Ridge
29	Hutchins	L-58	Stickney
30	Burning Well		

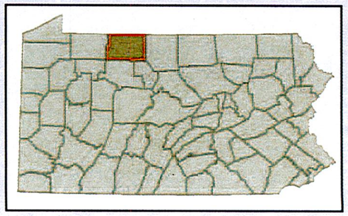


Table 1. Natural Heritage Areas categorized by significance. The results of the Natural Heritage Inventory are summarized below in both graphic and tabular form. Figure 1 shows the spatial distribution of Natural Heritage Areas across the county. Table 1 summarizes the Natural Heritage Areas, in order of their ecological significance. Significance ranks are Exceptional, High, Notable, and County (for a full explanation of these ranks, see Table 4 on pg. 33).

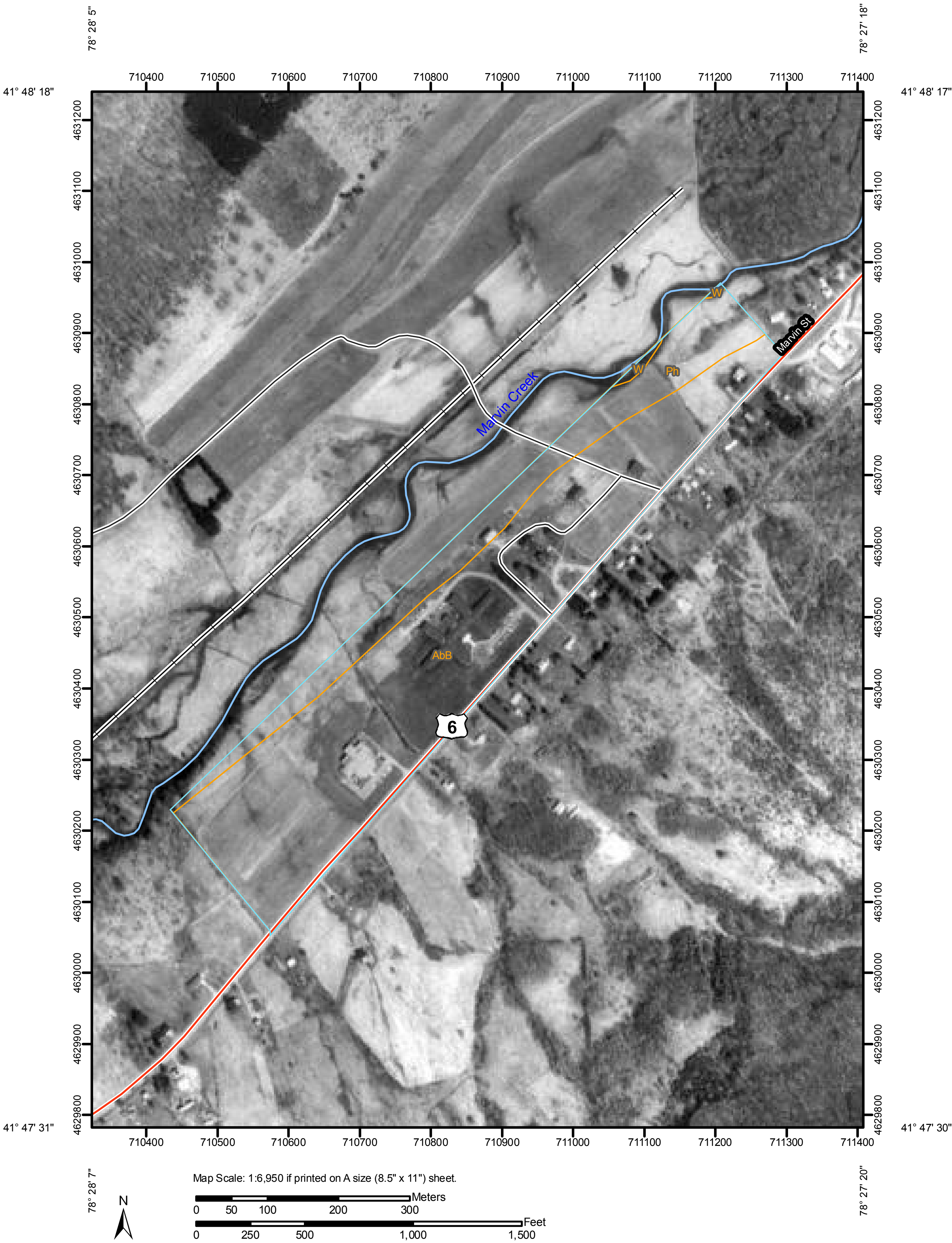
Site	Municipality	Description	Page
Exceptional Significance			
Allegheny Portage Creek CA	Liberty Township	Aquatic habitat occupied by one fish and two mussel species and sensitive species of concern 1, 2, and 3.	119
Allegheny River at Turtlepoint CA	Annin Township	Stream habitat that supports one fish and two mussel species of conservation concern and sensitive species of concern 2, 3, and 5.	49
Bingham CA	Keating Township, Lafayette Township	Disturbed habitat and adjacent wetland that serve as habitat for three plant species of concern.	101, 111
Cathrine Swamp CA	Hamlin Township, Sergeant Township	Wetland complex serving as habitat for two plant, six dragonfly, and 1 butterfly species of special concern.	95, 135
Indian Crossing Swamp CA	Eldred Township	Wetland complex with globally rare black ash - balsam fir swamp natural community providing habitat for two plants species, Wilson's snipe, and sensitive species of concern 8.	77
Kinzua Creek CA	Hamilton Township, Wetmore Township	Section of Kinzua Creek and riparian forest providing habitat for American brook lamprey and six species of river odonates.	89, 143
Midmont Swamp CA	Sergeant Township, Jones Township, Elk County	Beaver-influenced wetland complex supporting hemlock palustrine forest, Wiegand's sedge, bog sedge, creeping snowberry, northern Harrier, and sensitive species of concern 9.	138
Ormsby Swamp CA	Keating Township	Wetland complex serving as habitat for two plant, seven dragonfly, and six butterfly species of special concern and sensitive species of concern 11.	104
Oswayo Creek CA	Ceres Township	Stream habitat supporting populations of Ohio lamprey and three mussel species of special concern.	61
Potato Creek CA	Keating Township, Norwich Township,	Section of upper Potato Creek and its tributaries support American brook lamprey and Ohio lamprey and sensitive species of concern 2 and 3.	103, 125
Potato Creek at Farmers Valley CA	Keating Township,	Section of lower Potato Creek and its tributaries support American brook lamprey, three mussel species of concern, and sensitive species of concern 2, 3, and 5.	103
Potato Creek LCA	Foster Township, Keating Township, Liberty Township, Norwich Township, Otto Township, Sergeant Township	Section of Potato Creek, its tributaries, and supporting riparian corridors that encompass a number of smaller-scale aquatic Conservation Areas.	42
State Line LCA	Corydon Township, Warren County, New York State	Landscape encompassing nearly 12,500 acres of highly contiguous forest.	43
Swede Hill CA	Hamilton Township, Wetmore Township	Section of South Branch Kinzua Creek and riparian forest that serves as habitat for three species of river-breeding odonates.	143
Tracy Ridge LCA	Corydon Township, Warren County	Landscape encompassing nearly 9,800 acres of highly contiguous forest.	43

Table 1. Natural Heritage Areas categorized by significance (cont.).

Site	Municipality	Description	Page No.
Exceptional Significance (cont.)			
Upper Allegheny River LCA	Annin Township, Eldred Township, Keating Township, Liberty Township, Norwich Township, Potter County	Sections of Allegheny Portage Creek, Allegheny River, their tributaries, and supporting riparian corridors that encompass a number of smaller-scale aquatic Conservation Areas.	42
High Significance			
Allegheny River at Larabee CA	Eldred Township	Stream habitat that supports elktoe mussel, blue-tipped dancer dragonfly, and long dash butterfly, all species of special concern.	75
Allegheny Wetland Complex LCA	Annin Township, Eldred Township, Keating Township,	Landscape encompassing a wetland complex along the Allegheny River greater than 6,000 acres.	41
Briggs Run CA	Hamilton Township	Small stream supporting a population of great-spurred violet.	87
Brown Valley CA	Bradford Township	Mixed hemlock - hardwood riparian forest that supports a breeding pair of Swainson's thrush.	55
Bullis Mills CA	Eldred Township	Riparian wetland habitat occupied by a nesting pair of Wilson's snipe and sensitive species of concern 7.	76
Burning Well CA	Sergeant Township	Seepy valley head occupied by a small stand of balsam poplar, a critically imperiled plant species in Pennsylvania.	135
Chappel Bay CA	Hamilton Township	Shoreline along reservoir serving as habitat for thread rush, a state-rare plant species.	87
Cobb Hollow Upland CA	Bradford Township, Foster Township	Upland forest that supports a breeding pair of Swainson's thrush.	56, 83
Coffey Run CA	Corydon Township	Hemlock-dominated forest along Coffey Run that supports a breeding pair of Swainson's thrush, a species of conservation concern in PA.	67
Coryville Railroad Grade CA	Eldred Township, Keating Township	Marshy habitat along an active railroad grade that supports a relatively large population of stalked bulrush, a critically imperiled plant in Pennsylvania.	77, 102
Crane Run CA	Wetmore Township, Elk County	Aquatic habitat for American brook lamprey and ocellated darner dragonfly, both species of conservation concern.	143
Elk River LCA	Norwich Township, Sergeant Township Elk County	Landscape encompassing over 35,000 acres of contiguous forest.	43
Elk State Forest CA	Sergeant Township	Section of abandoned railroad grade serving as habitat for Case's Ladies'-tresses, a critically imperiled orchid species in PA.	137
Havens Run CA	Norwich Township	Section of stream that provides habitat for American brook lamprey, a fish species of special concern.	125
Hutchins CA	Sergeant Township	Upland forest habitat supporting sensitive species of concern 4.	137
Kasson Railroad Grade CA	Hamlin Township, Keating Township	Open habitat along railroad grade supporting a population of Case's ladies'-tresses, a critically imperiled orchid species.	96, 101
Keating Summit LCA	Liberty Township, Norwich Township, Elk County, Potter County	Landscape encompassing an area of contiguous forest greater than 18,200 acres.	43

Annex IV.A.6-C1.

Site 1 Soil Map


78° 28' 5"
78° 27' 18"
41° 48' 18"
41° 48' 17"
41° 47' 31"
41° 47' 30"
78° 28' 7"
78° 27' 20"
710400
710500
710600
710700
710800
710900
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711100
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Marvin Creek
Marvin St
W
W
Ph
AbB
6
Map Scale: 1:6,950 if printed on A size (8.5" x 11") sheet.
N
Meters
0 50 100 200 300
Feet
0 250 500 1,000 1,500

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other

Special Line Features
- Gully
- Short Steep Slope
- Other

Political Features
- Cities

Water Features
- Oceans
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:6,950 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:20,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 17N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: McKean County, Pennsylvania
Survey Area Data: Version 5, Jul 31, 2009

Date(s) aerial images were photographed: 4/8/1993

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

McKean County, Pennsylvania (PA083)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
AbB	Albrights silt loam, 3 to 8 percent slopes	37.2	78.5%
Ph	Philo silt loam	9.9	21.0%
W	Water	0.3	0.6%
Totals for Area of Interest		**47.4**	**100.0%**

Annex IV.A.6-C2.

Site 1 Soil Data

Map Unit Description

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions in this report, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. All the soils of a series have major horizons that are similar in composition, thickness, and arrangement. Soils of a given series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Additional information about the map units described in this report is available in other soil reports, which give properties of the soils and the limitations, capabilities, and potentials for many uses. Also, the narratives that accompany the soil reports define some of the properties included in the map unit descriptions.

McKean County, Pennsylvania

AbB—Albrights silt loam, 3 to 8 percent slopes

Map Unit Setting

Elevation: 500 to 1,500 feet
Mean annual precipitation: 35 to 51 inches
Mean annual air temperature: 41 to 62 degrees F
Frost-free period: 115 to 165 days

Map Unit Composition

Albrights and similar soils: 85 percent
Minor components: 5 percent

Description of Albrights

Setting

Landform: Mountain slopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Mountainbase
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Residuum weathered from acid, red siltstone, sandstone, and shale

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 18 to 32 inches to fragipan
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: About 12 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 2.7 inches)

Interpretive groups

Land capability (nonirrigated): 2e

Typical profile

0 to 8 inches: Silt loam
8 to 19 inches: Gravelly silt loam
19 to 70 inches: Channery clay loam

Minor Components

Brinkerton

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave

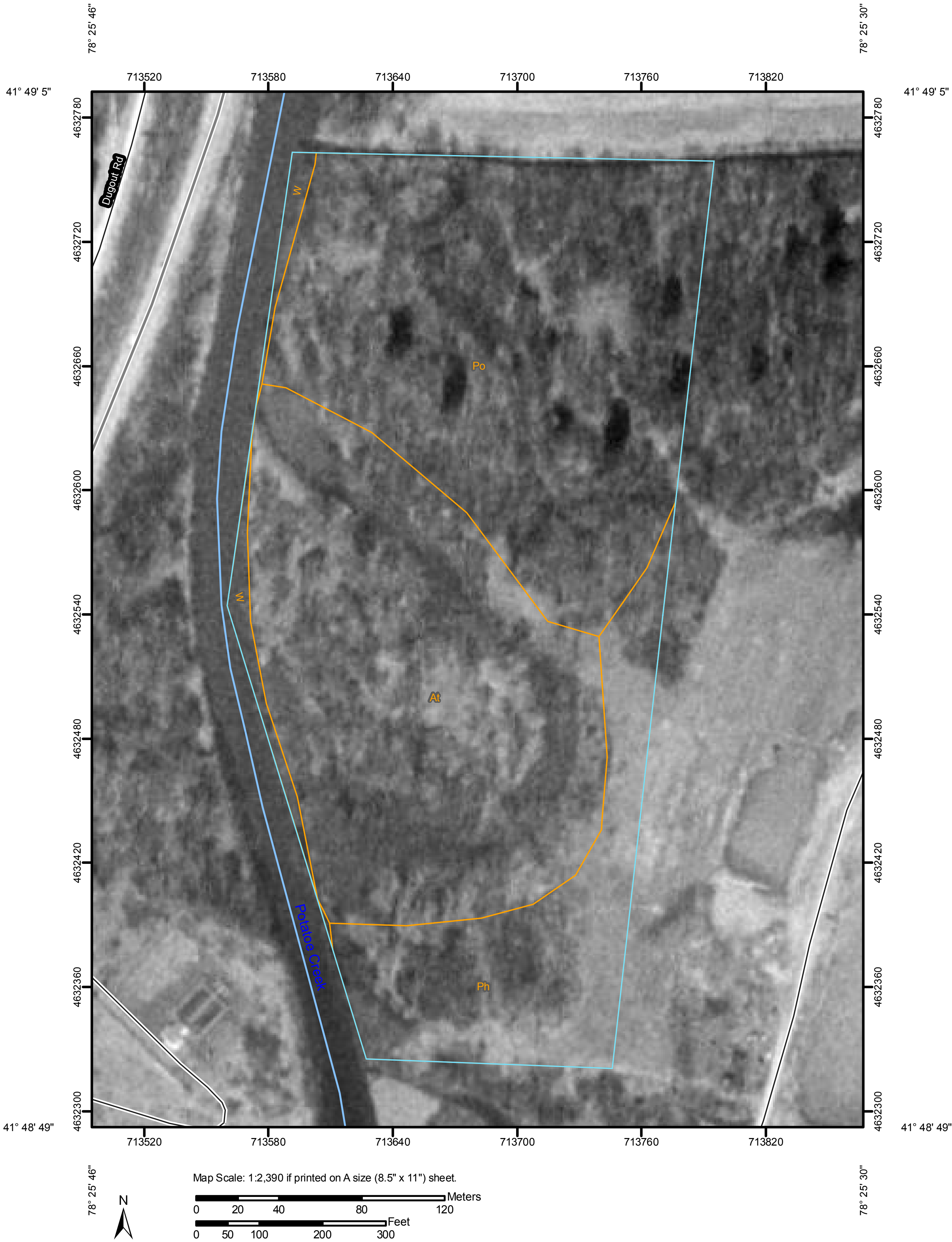
Data Source Information

Soil Survey Area: McKean County, Pennsylvania
Survey Area Data: Version 5, Jul 31, 2009

Annex IV.A.6-C3.

Site 2 Soil Map

Soil Map—McKean County, Pennsylvania
(Smethport Site No. 2)



Map Scale: 1:2,390 if printed on A size (8.5" x 11") sheet.

N

Meters: 0 20 40 80 120

Feet: 0 50 100 200 300

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other

Special Line Features
- Gully
- Short Steep Slope
- Other

Political Features
- Cities

Water Features
- Oceans
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:2,390 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:20,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 17N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: McKean County, Pennsylvania
Survey Area Data: Version 5, Jul 31, 2009

Date(s) aerial images were photographed: 4/8/1993

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

McKean County, Pennsylvania (PA083)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
At	Atkins silt loam	7.8	38.9%
Ph	Philo silt loam	3.3	16.6%
Po	Pope loam	8.5	42.4%
W	Water	0.4	2.1%
Totals for Area of Interest		**20.1**	**100.0%**

Annex IV.A.6-C4.

Site 2 Soil Data

Map Unit Description

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions in this report, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. All the soils of a series have major horizons that are similar in composition, thickness, and arrangement. Soils of a given series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Additional information about the map units described in this report is available in other soil reports, which give properties of the soils and the limitations, capabilities, and potentials for many uses. Also, the narratives that accompany the soil reports define some of the properties included in the map unit descriptions.

McKean County, Pennsylvania

At—Atkins silt loam

Map Unit Setting

Elevation: 1,500 to 2,500 feet
Mean annual precipitation: 38 to 46 inches
Mean annual air temperature: 46 to 57 degrees F
Frost-free period: 140 to 170 days

Map Unit Composition

Atkins and similar soils: 85 percent
Minor components: 5 percent

Description of Atkins

Setting

Landform: Flood plains
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 60 to 99 inches to lithic bedrock
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.06 to 2.00 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Available water capacity: High (about 9.0 inches)

Interpretive groups

Land capability (nonirrigated): 3w

Typical profile

0 to 9 inches: Silt loam
9 to 36 inches: Silt loam
36 to 64 inches: Stratified gravelly sandy loam to silty clay loam

Minor Components

Elkins

Percent of map unit: 5 percent
Landform: Flood plains
Down-slope shape: Concave
Across-slope shape: Linear
Other vegetative classification: Wetlands (W3)

Data Source Information

Soil Survey Area: McKean County, Pennsylvania
Survey Area Data: Version 5, Jul 31, 2009

Annex IV.A.6-C5.

Site 2 Soil Data

Map Unit Description

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions in this report, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. All the soils of a series have major horizons that are similar in composition, thickness, and arrangement. Soils of a given series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Additional information about the map units described in this report is available in other soil reports, which give properties of the soils and the limitations, capabilities, and potentials for many uses. Also, the narratives that accompany the soil reports define some of the properties included in the map unit descriptions.

McKean County, Pennsylvania

Po—Pope loam

Map Unit Setting

Mean annual precipitation: 35 to 51 inches
Mean annual air temperature: 46 to 55 degrees F
Frost-free period: 115 to 165 days

Map Unit Composition

Pope and similar soils: 85 percent
Minor components: 6 percent

Description of Pope

Setting

Landform: Flood plains
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Recent alluvium

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Available water capacity: Moderate (about 8.7 inches)

Interpretive groups

Land capability (nonirrigated): 2w

Typical profile

0 to 6 inches: Loam
6 to 41 inches: Fine sandy loam
41 to 65 inches: Sandy loam

Minor Components

Atkins

Percent of map unit: 6 percent
Landform: Flood plains
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Linear

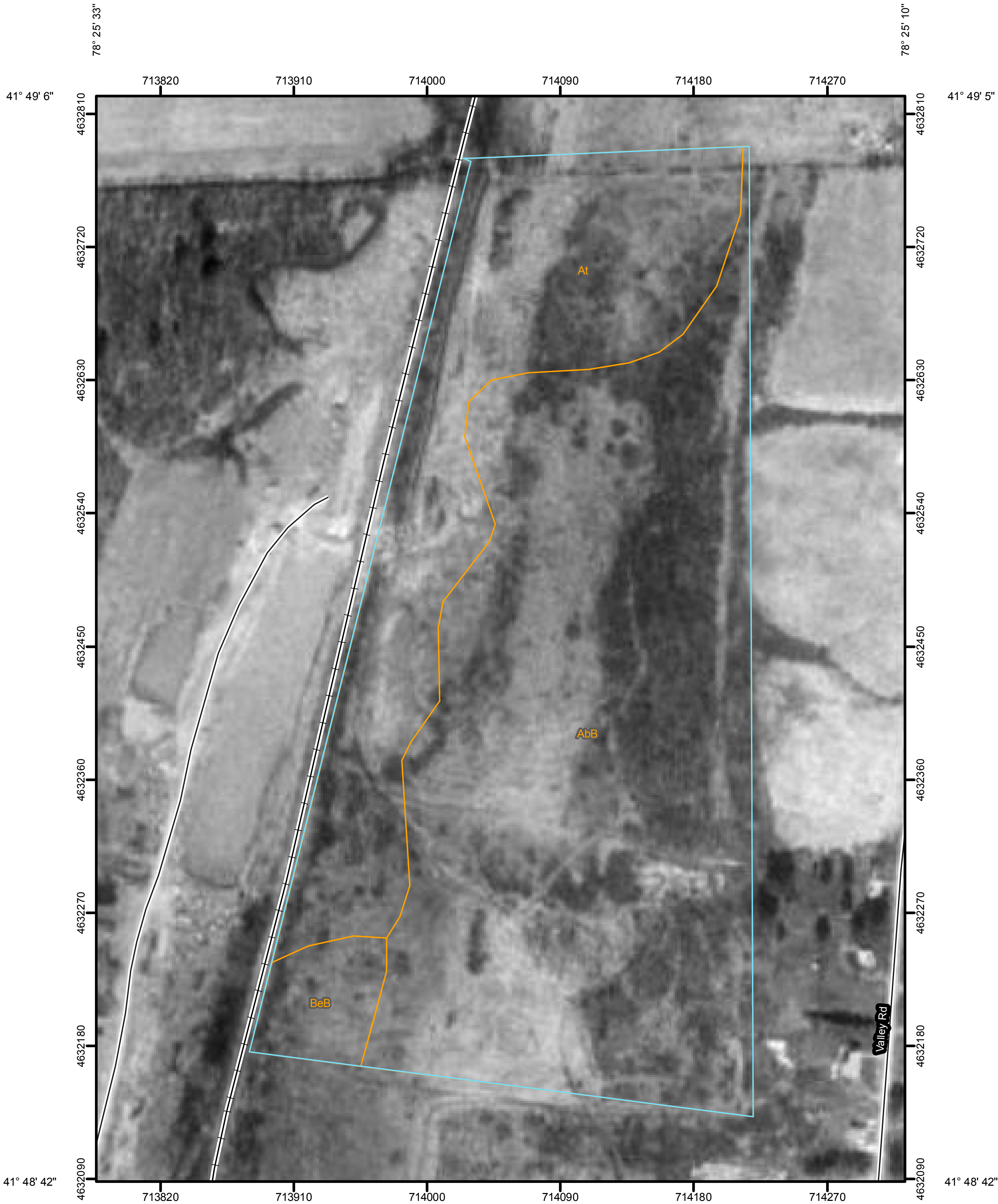
Data Source Information

Soil Survey Area: McKean County, Pennsylvania
Survey Area Data: Version 5, Jul 31, 2009

Annex IV.A.6-C6.

Site 3 Soil Map

Soil Map—McKean County, Pennsylvania
(Smethport Site No. 3)



Map Scale: 1:3,500 if printed on A size (8.5" x 11") sheet.

N

Meters: 0 30 60 120 180

Feet: 0 100 200 400 600

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other

Special Line Features
- Gully
- Short Steep Slope
- Other

Political Features
- Cities

Water Features
- Oceans
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:3,500 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:20,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 17N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: McKean County, Pennsylvania
Survey Area Data: Version 5, Jul 31, 2009

Date(s) aerial images were photographed: 4/8/1993

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

McKean County, Pennsylvania (PA083)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
AbB	Albrights silt loam, 3 to 8 percent slopes	27.3	65.9%
At	Atkins silt loam	12.6	30.5%
BeB	Braceville silt loam, 3 to 8 percent slopes	1.5	3.6%
Totals for Area of Interest		**41.4**	**100.0%**

Annex IV.A.6-C7.

Site 3 Soil Data

Map Unit Description

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions in this report, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. All the soils of a series have major horizons that are similar in composition, thickness, and arrangement. Soils of a given series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Additional information about the map units described in this report is available in other soil reports, which give properties of the soils and the limitations, capabilities, and potentials for many uses. Also, the narratives that accompany the soil reports define some of the properties included in the map unit descriptions.

McKean County, Pennsylvania

AbB—Albrights silt loam, 3 to 8 percent slopes

Map Unit Setting

Elevation: 500 to 1,500 feet
Mean annual precipitation: 35 to 51 inches
Mean annual air temperature: 41 to 62 degrees F
Frost-free period: 115 to 165 days

Map Unit Composition

Albrights and similar soils: 85 percent
Minor components: 5 percent

Description of Albrights

Setting

Landform: Mountain slopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Mountainbase
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Residuum weathered from acid, red siltstone, sandstone, and shale

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 18 to 32 inches to fragipan
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: About 12 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 2.7 inches)

Interpretive groups

Land capability (nonirrigated): 2e

Typical profile

0 to 8 inches: Silt loam
8 to 19 inches: Gravelly silt loam
19 to 70 inches: Channery clay loam

Minor Components

Brinkerton

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave

Data Source Information

Soil Survey Area: McKean County, Pennsylvania
Survey Area Data: Version 5, Jul 31, 2009

Annex IV.A.6-C8.

Site 3 Soil Data

Map Unit Description

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions in this report, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. All the soils of a series have major horizons that are similar in composition, thickness, and arrangement. Soils of a given series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Additional information about the map units described in this report is available in other soil reports, which give properties of the soils and the limitations, capabilities, and potentials for many uses. Also, the narratives that accompany the soil reports define some of the properties included in the map unit descriptions.

McKean County, Pennsylvania

At—Atkins silt loam

Map Unit Setting

Elevation: 1,500 to 2,500 feet
Mean annual precipitation: 38 to 46 inches
Mean annual air temperature: 46 to 57 degrees F
Frost-free period: 140 to 170 days

Map Unit Composition

Atkins and similar soils: 85 percent
Minor components: 5 percent

Description of Atkins

Setting

Landform: Flood plains
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 60 to 99 inches to lithic bedrock
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.06 to 2.00 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Available water capacity: High (about 9.0 inches)

Interpretive groups

Land capability (nonirrigated): 3w

Typical profile

0 to 9 inches: Silt loam
9 to 36 inches: Silt loam
36 to 64 inches: Stratified gravelly sandy loam to silty clay loam

Minor Components

Elkins

Percent of map unit: 5 percent
Landform: Flood plains
Down-slope shape: Concave
Across-slope shape: Linear
Other vegetative classification: Wetlands (W3)

Data Source Information

Soil Survey Area: McKean County, Pennsylvania
Survey Area Data: Version 5, Jul 31, 2009

Annex IV.A.6-C9.

Site 3 Soil Data

Map Unit Description

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions in this report, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. All the soils of a series have major horizons that are similar in composition, thickness, and arrangement. Soils of a given series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Additional information about the map units described in this report is available in other soil reports, which give properties of the soils and the limitations, capabilities, and potentials for many uses. Also, the narratives that accompany the soil reports define some of the properties included in the map unit descriptions.

McKean County, Pennsylvania

BeB—Braceville silt loam, 3 to 8 percent slopes

Map Unit Setting

Mean annual precipitation: 36 to 46 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 120 to 160 days

Map Unit Composition

Braceville and similar soils: 85 percent
Minor components: 5 percent

Description of Braceville

Setting

Landform: Outwash terraces
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Coarse-loamy outwash

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 20 to 32 inches to fragipan
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.60 in/hr)
Depth to water table: About 16 to 28 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 2.6 inches)

Interpretive groups

Land capability (nonirrigated): 2e

Typical profile

0 to 8 inches: Silt loam
8 to 24 inches: Gravelly loam
24 to 36 inches: Gravelly sandy loam
36 to 60 inches: Stratified gravel to sand

Minor Components

Halsey

Percent of map unit: 5 percent
Landform: Depressions on outwash terraces
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Linear

Data Source Information

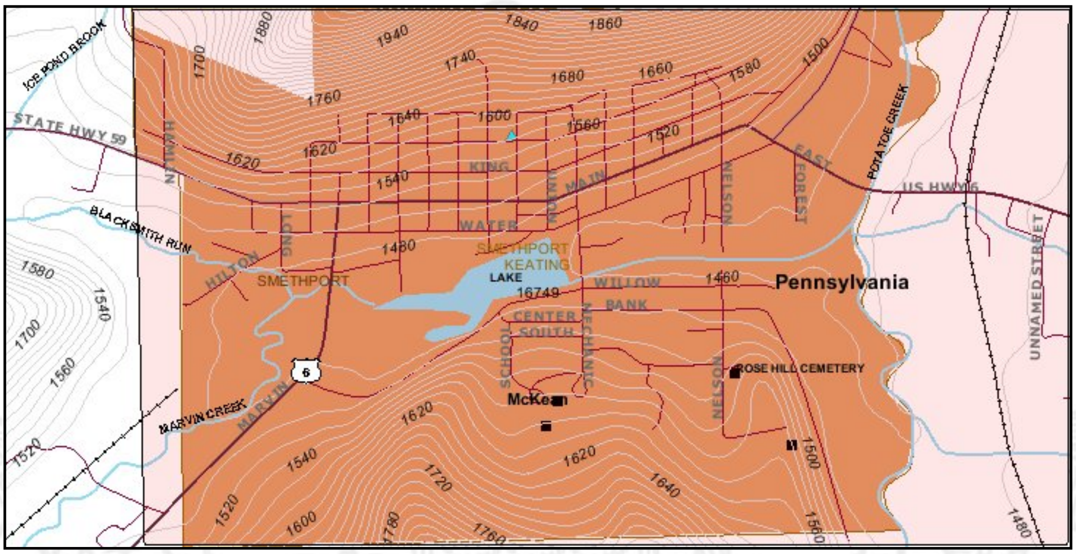
Soil Survey Area: McKean County, Pennsylvania
Survey Area Data: Version 5, Jul 31, 2009

Annex IV.A.6-E.

PNDI – Project Environmental Review Receipt

1. PROJECT INFORMATION

Project Name: **Smethport**
Date of review: **10/12/2009 8:37:34 AM**
Project Category: **Energy Storage, Production, and Transfer,Energy Production (generation),Other**
Project Area: **1434.2** acres
County: **Mckean** Township/Municipality: **Smethport,Keating**
Quadrangle Name: **SMETHPORT**
ZIP Code: **16749**
Decimal Degrees: **41.79893 N, --78.45956 W**
Degrees Minutes Seconds: **41° 47' 56.2" N, -78° 27' 34.5" W**



2. SEARCH RESULTS

Agency	Results	Response
PA Game Commission	No Known Impact	No Further Review Required
PA Department of Conservation and Natural Resources	No Known Impact	No Further Review Required
PA Fish and Boat Commission	**Potential Impact**	**FURTHER REVIEW IS REQUIRED, See Agency Response**
U.S. Fish and Wildlife Service	No Known Impact	No Further Review Required

As summarized above, Pennsylvania Natural Diversity Inventory (PNDI) records indicate there may be potential impacts to threatened and endangered and/or special concern species and resources within the project area. If the response above indicates "No Further Review Required" no additional communication with the respective agency is required. If the response is "Further Review Required" or "See Agency Response," refer to the appropriate agency comments below. Please see the DEP Information Section of this receipt if a PA Department of Environmental Protection Permit is required.

3. AGENCY COMMENTS

Regardless of whether a DEP permit is necessary for this proposed project, any potential impacts to threatened and endangered species and/or special concern species and resources must be resolved with the appropriate jurisdictional agency. In some cases, a permit or authorization from the jurisdictional agency may be needed if adverse impacts to these species and habitats cannot be avoided.

These agency determinations and responses are **valid for one year** (from the date of the review), and are based on the project information that was provided, including the exact project location; the project type, description, and features; and any responses to questions that were generated during this search. If any of the following change: 1) project location, 2) project size or configuration, 3) project type, or 4) responses to the questions that were asked during the online review, the results of this review are not valid, and the review must be searched again via the PNDI Environmental Review Tool and resubmitted to the jurisdictional agencies. The PNDI tool is a primary screening tool, and a desktop review may reveal more or fewer impacts than what is listed on this PNDI receipt.

PA Game Commission

RESPONSE: No Impact is anticipated to threatened and endangered species and/or special concern species and resources.

PA Department of Conservation and Natural Resources

RESPONSE: No Impact is anticipated to threatened and endangered species and/or special concern species and resources.

PA Fish and Boat Commission

PFBC Species:
Scientific Name: Alasmidonta marginata
Common Name: Elktoe
Current Status: Special Concern Species*
Proposed Status: Special Concern Species*

Scientific Name: Lasmigona compressa
Common Name: Creek Heelsplitter
Current Status: Special Concern Species*
Proposed Status: Special Concern Species*

RESPONSE: Further review of this project is necessary to resolve the potential impacts(s). Please send project information to this agency for review (see WHAT TO SEND).

U.S. Fish and Wildlife Service

RESPONSE: No impacts to **federally** listed or proposed species are anticipated. Therefore, no further consultation/coordination under the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.* is required. Because no take of federally listed species is anticipated, none is authorized. This response does not reflect potential Fish and Wildlife Service concerns under the Fish and Wildlife Coordination Act or other authorities.

* Special Concern Species or Resource - Plant or animal species classified as rare, tentatively undetermined or candidate as well as other taxa of conservation concern, significant natural communities, special concern populations (plants or animals) and unique geologic features.
** Sensitive Species - Species identified by the jurisdictinal agency as collectible, having economic value, or being susceptible to decline as a result of visitation.

WHAT TO SEND TO JURISDICTIONAL AGENCIES

If project information was requested by one or more of the agencies above, send the following information to the agency(s) seeking this information (see AGENCY CONTACT INFORMATION).

Check-list of *Minimum* Materials to be submitted:

____**SIGNED** copy of this Project Environmental Review Receipt
____Project narrative with a description of the overall project, the work to be preformed, current physical characteristics of the site and acreage to be impacted.
____Project location information (name of USGS Quadrangle, Township/Municipality, and County)
____USGS 7.5-minute Quadrangle with project boundary clearly indicated, and quad name on the map

The inclusion of the following information may expedite the review process.
____A basic site plan(particularly showing the relationship of the project to the physical features such as wetlands, streams, ponds, rock outcrops, etc.)
____Color photos keyed to the basic site plan (i.e. showing on the site plan where and in what direction each photo was taken and the date of the photos)
____Information about the presence and location of wetlands in the project area, and how this was determined (e.g., by a qualified wetlands biologist), if wetlands are present in the project area, provide project plans showing the location of all project features, as well as wetlands and streams
____The DEP permit(s) required for this project

4. DEP INFORMATION

The Pa Department of Environmental Protection (DEP) requires that a signed copy of this receipt, along with any required documentation from jurisdictional agencies concerning resolution of potential impacts, be submitted with applications for permits requiring PNDI review. For cases where a "Potential Impact" to threatened and endangered species has been identified before the application has been submitted to DEP, the application should not be submitted until the impact has been resolved. For cases where "Potential Impact" to special concern species and resources has been identified before the application has been submitted, the application should be submitted to DEP along with the PNDI receipt, a completed PNDI form and a USGS 7.5 minute quadrangle map with the project boundaries delineated on the map. The PNDI Receipt should also be submitted to the appropriate agency according to directions on the PNDI Receipt. DEP and the jurisdictional agency will work together to resolve the potential impact(s). See the DEP PNDI policy at http://www.naturalheritage.state.pa.us.

5. ADDITIONAL INFORMATION

The PNDI environmental review website is a **preliminary** screening tool. There are often delays in updating species status classifications. Because the proposed status represents the best available information regarding the conservation status of the species, state jurisdictional agency staff give the proposed statuses at least the same consideration as the current legal status. If surveys or further information reveal that a threatened and endangered and/or special concern species and resources exist in your project area, contact the appropriate jurisdictional agency/agencies immediately to identify and resolve any impacts.

For a list of species known to occur in the county where your project is located, please see the species lists by county found on the PA Natural Heritage Program (PNHP) home page (www.naturalheritage.state.pa.us). Also note that the PNDI Environmental Review Tool only contains information about species occurrences that have actually been reported to the PNHP.

6. AGENCY CONTACT INFORMATION

PA Department of Conservation and Natural Resources

Bureau of Forestry, Ecological Services Section
400 Market Street, PO Box 8552, Harrisburg, PA. 17105-8552
Fax:(717) 772-0271

U.S. Fish and Wildlife Service

Endangered Species Section
315 South Allen Street, Suite 322, State College, PA. 16801-4851
NO Faxes Please.

PA Fish and Boat Commission

Division of Environmental Services
450 Robinson Lane, Bellefonte, PA. 16823-7437
NO Faxes Please

PA Game Commission

Bureau of Wildlife Habitat Management
Division of Environmental Planning and Habitat Protection
2001 Elmerton Avenue, Harrisburg, PA. 17110-9797
Fax:(717) 787-6957

7. PROJECT CONTACT INFORMATION

Name:____
Company/Business Name:______________________________
Address:____
City, State, Zip:_____________________________________
Phone:(____)_____________________Fax:(_____)_______________
Email:____

8. CERTIFICATION

I certify that ALL of the project information contained in this receipt (including project location, project size/configuration, project type, answers to questions) is true, accurate and complete. In addition, if the project type, location, size or configuration changes, or if the answers to any questions that were asked during this online review change, I agree to re-do the online environmental review.

________________________________ ____________________
applicant/project proponent signature date

McKean County State Species Types

To copy these items use ctrl-a, then you can paste into other applications like word processors, spreadsheets, etc.

Scientific Name	Common Name	Global Rank	State Rank	State Status	Proposed State Status	Federal Status
Carex wiegandii	Wiegands Sedge	G4	S1	PT	PT	
Gomphus descriptus	Harpoon Clubtail	G4	S1S2			
Accipiter gentilis	Northern Goshawk	G5	S2S3B,S3N		CR	
Aeshna tuberculifera	Black-tipped Darner	G4	S2S3			
Empidonax flaviventris	Yellow-bellied Flycatcher	G5	S1S2B	PE	PE	
Ophiogomphus mainensis	Maine Snaketail	G4	S3			
Phoxinus erythrogaster	Southern Redbelly Dace	G5	S1	PT	PT	
Sylvilagus obscurus	Appalachian Cottontail	G4	SU			
Lampsilis fasciola	Wavy-rayed Lampmussel	G5	S4		N	
Aeshna verticalis	Green-striped Darner	G5	S3S4			
Satyrodes eurydice	Eyed Brown	G4	S3			
Liochlorophis vernalis	Smooth Green Snake	G5	S3S4			
Viburnum trilobum	Highbush-cranberry	G5T5	S3S4	TU	PR	
Lanthus parvulus	Northern Pygmy Clubtail	G4	S3S4			
Calopteryx amata	Superb Jewelwing	G4	S2S3			
Gaultheria hispidula	Creeping Snowberry	G5	S3	PR	PR	
Ichthyomyzon bdellium	Ohio Lamprey	G3G4	S2S3	PC	CP	

Scirpus pedicellatus	Stalked Bulrush	G4	S1	PT	PT	
Ribes triste	Red Currant	G5	S2	PT	PT	
Catharus ustulatus	Swainson's Thrush	G5	S2S3B,S5N		CR	
Leucorrhinia proxima	Red-waisted Whiteface	G5	S2			
Populus balsamifera	Balsam Poplar	G5	S1	PE	PE	
Lycaena hyllus	Bronze Copper	G5	S3			
Argia tibialis	Blue-tipped Dancer	G5	S1			
Amelanchier bartramiana	Oblong-fruited Serviceberry	G5	S1	PE	PE	
Percina copelandi	Channel Darter	G4	S2		PT	
High-gradient clearwater creek	High-gradient Clearwater Creek	GNR	S3			
Somatochlora elongata	Ski-tailed Emerald	G5	S2			
Parthenium integrifolium	American Fever-few	G5	S1	TU	PE	
Pleurobema sintoxia	Round Pigtoe	G4G5	S2		PE	
Crotalus horridus	Timber Rattlesnake	G4	S3S4	PC	CA	
Alisma triviale	Northern Water-plantain	G5	S1	PE	PE	
Glaucomys sabrinus	Northern Flying Squirrel	G5	SU	PE		
Gallinago delicata	Wilson's Snipe	G5	S3B,S3N		CR	
Ardea herodias	Great Blue Heron	G5	S3S4B,S4N			
Speyeria atlantis	Atlantis Fritillary	G5	S3			
Somatochlora forcipata	Forcipate Emerald	G5	S2			
Cordulia shurtleffi	American Emerald	G5	S3S4			

Chlosyne harrisii	Harris' Checkerspot	G4	S3			
Hesperia sassacus	Indian Skipper	G5	S3			
Somatochlora walshii	Brush-tipped Emerald	G5	S2			
Thamnophis brachystoma	Shorthead Garter Snake	G4	S3			
Carex ormostachya	Spike Sedge	G4	S2	N	PT	
Ichthyomyzon greeleyi	Mountain Brook Lamprey	G3G4	S2	PT	PT	
Filipendula rubra	Queen-of-the-prairie	G4G5	S1S2	TU	TU	
Boyeria grafiana	Ocellated Darner	G5	S3			
Myotis septentrionalis	Northern Myotis	G4	S3B,S3N		CR	
Haliaeetus leucocephalus	Bald Eagle	G5	S2B	PT	PT	
Lasionycteris noctivagans	Silver-haired Bat	G5	SUB		CR	
Hesperia leonardus	Leonard's Skipper	G4	S3			
Sorex palustris albibarbis	Water Shrew	G5T5	S3		CR	
Spiranthes casei	Case's Ladies'-tresses	G4	S1	PE	PE	
Stylurus scudderi	Zebra Clubtail	G4	S1			
Epilobium strictum	Downy Willow-herb	G5?	S3	PE	PR	
Pandion haliaetus	Osprey	G5	S2B	PT	PT	
Boloria selene myrina	Silver Bordered Fritillary	G5T5	S3			
Viola selkirkii	Great-spurred Violet	G5?	S3S4	N	PR	
Lota lota	Burbot	G5	S1S2	PE	PE	
Juncus filiformis	Thread Rush	G5	S3	PR	PR	

Streptopus amplexifolius	White Twisted-stalk	G5	S1	PT	PE	
Cardamine maxima	Large Toothwort	G5	S2	N	PT	
Hemlock (white pine) - northern hardwood forest		GNR	S5			
Lampetra appendix	American Brook Lamprey	G4	S3	PC	CP	
Lasmigona compressa	Creek Heelsplitter	G5	S2S3		CR	
Alasmidonta marginata	Elktoe	G4	S4		N	
Sympetrum obtrusum	White-faced Meadowhawk	G5	S3S4			
Carex careyana	Carey's Sedge	G4G5	S1	PE	PE	
Red spruce palustrine forest		GNR	S3			
Erosional remnant	Erosional Remnant	GNR	SNR			
Percina macrocephala	Longhead Darter	G3	S2S3		PT	
Notropis dorsalis	Bigmouth Shiner	G5	S2	PT	PT	
Fusconaia subrotunda	Long-solid	G3	S1		PE	
Leucorrhinia glacialis	Crimson-ringed Whiteface	G5	S3S4			
Eumeces anthracinus	Coal Skink	G5	S3			

Elktoe (Alasmidonta marginata)

Freshwater Mussel Species of Concern

State Rank: S4 (apparently secure), Global Rank: G4 (apparently secure)

Identification

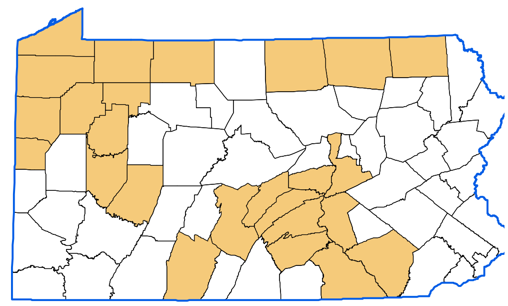
The Elktoe (*Alasmidonta marginata*) is a moderately sized mussel, commonly reaching 75 mm in length. The shell is trapezoidal or rhomboid shaped, inflated, and thin (Parmalee 1998, Strayer and Jirka 1997). The anterior margin is rounded, with a somewhat straight ventral margin. The ventral and posterior margins meet in a blunt, squared point (Parmalee 1998). The posterior ridge is the focal point of the shell and is sharply angled. The posterior slope is flattened with fine, well-developed ridges crossing the growth lines. The beaks are high, inflated, and are comprised of three to four heavy double-looped ridges. The periostracum (outer covering) is usually yellowish or greenish, with green rays and darker spots that may appear connected to the rays (rays may appear interrupted). Lateral teeth are vestigial and appear as nothing more than indistinct bumps along the hinge line. The nacre (inner iridescent coloring) is usually bluish-white (Parmalee 1998; Sietman 2003; Strayer and Jirka 1997).

Photo: http://www.lwatrous.com/missouri_mollusks/mussels/images/a_marginata.jpg

Habitat

The Elktoe can be found in medium to large size streams, but is most common in smaller streams. This species is present in greatest abundance in small shallow rivers with a moderately fast current and riffles. The preferred substrate is fine gravel mixed with sand (Parmalee 1998; Sietman 2003; Strayer and Jirka 1997; NatureServe 2005).

Pennsylvania Distribution by County



Pennsylvania Natural Heritage Program data 2007

Host Fish

Hosts for Elktoe glochidia include the white sucker, northern hogsucker, shorthead redhorse, rockbass, and warmouth (Parmalee 1998; Strayer and Jirka 1997).

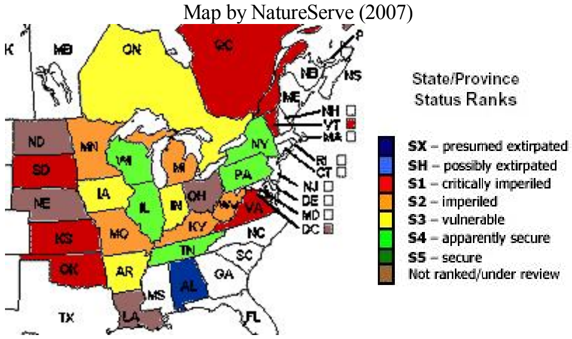
Status

Populations of *Alasmidonta marginata* can be found from Ontario, Canada to Alabama. Its eastern boundary ranges along the east coast from New York to Virginia and the western boundary ranges from North Dakota to Oklahoma. Most populations are located in Ohio, Indiana, and Illinois. This mussel is thought to have been extirpated from Alabama since it has not been reported during surveys for several decades (NatureServe 2005; Parmalee 1998; Strayer and Jirka 1997). This species is not common in Pennsylvania but has been found in the Susquehanna River and Ohio drainages. The proposed state status of the Elktoe is not ranked (N), meaning there is insufficient data available to provide an adequate basis for assignment to specific categories concerning the security of known populations (PNHP). The state rank of this species suggests it is secure at some sites within Pennsylvania state boundaries. However, more surveys are required to determine the status of this species and other freshwater mussels in Pennsylvania.

Alasmidonta marginata is typically thought of as an interior basin species. It is not well understood how *Alasmidonta marginata* reached the Susquehanna River basin from its native range. Some researchers believe it may have drifted from the Allegheny River basin to Susquehanna via postglacial influences. An alternative theory states this species was introduced to the Susquehanna River basin via human activity (Strayer and Jirka 1997).

North American State/Province Conservation Status

Map by NatureServe (2007)



References

NatureServe. 2007. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.2. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. (Accessed: September 4, 2007).

Parmalee, P.W. and Bogan, A.E. 1998. The Freshwater Mussels of Tennessee. The University of Tennessee, Knoxville, TN 328 pp.

Pennsylvania Natural Heritage Program. Biota of Concern In Pennsylvania (BOCIP) Lists. Website: www.naturalheritage.state.pa.us/invertebrates.aspx

Sietman, B.E. 2003. Field Guide to the Freshwater Mussels of Minnesota. Minnesota Department of Natural Resources, St. Paul, MN 140 pp.

Strayer, D.L. and K.J. Jirka. 1997. The Pearly Mussels of New York State. The New York State Education Dept., Albany, N.Y. 113 pp and plate

PNHP
Pennsylvania Natural Heritage Program

PENNSYLVANIA FISH & BOAT COMMISSION

Creek Heelsplitter
Lasmigona compressa

Freshwater Mussel Species of Concern

State Rank: S2S3 Global Rank: G5

Identification

The creek heelsplitter (*Lasmigona compressa*) is a moderately sized mussel, usually less than 100 mm in length. The shell is subtrapeziodal in shape, compressed, and moderately thick. Juvenile specimens can sometimes have a small dorsal wing (Strayer and Jirka 1997). The periostracum (outer covering) is somewhat smooth and varies from greenish (juvenile) to greenish-black (adult), sometimes with fine green rays (usually apparent in young individuals). The beak sculpture is obvious and double-looped (Sietman 2003; Strayer and Jirka 1997). Pseudocardinal teeth are present but are usually smooth and lamellar (reduced). Lateral teeth are delicate, but functional and interlocking. There is a prominent interdental tooth in the left valve between the lateral teeth and pseudocardinal teeth (Strayer and Jirka 1997). The nacre (inner iridescent coloring) is usually white, but can be cream or salmon colored (especially toward the beak cavity) (Sietman 2003; Strayer and Jirka 1997).

www.darbycreeks.org/creekheelsplitterLittleDarby72.jpg

Habitat

The creek heelsplitter is typically located in creeks, but can sometimes be observed in streams too small to adequately support other species of freshwater mussels (Strayer and Jirka 1997). It is most commonly found in headwaters of small or medium rivers in fine gravel or sand (Sietman 2003; www.nps.gov/miss/features/mussels/musselpages/creekheelsplitter.html).

Photo: PA Science Office TNC

Photo: PA Science Office TNC

Host Fish

Suitable host fish for the creek heelsplitter include the slimy sculpin, spotfin shiner, black crappie, and the yellow perch (Strayer and Jirka 1997; www.nps.gov/miss/features/mussels/musselpages/creekheelsplitter.html).

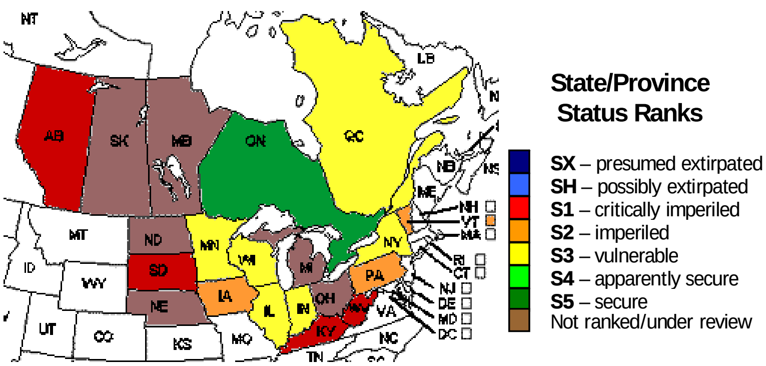
Status

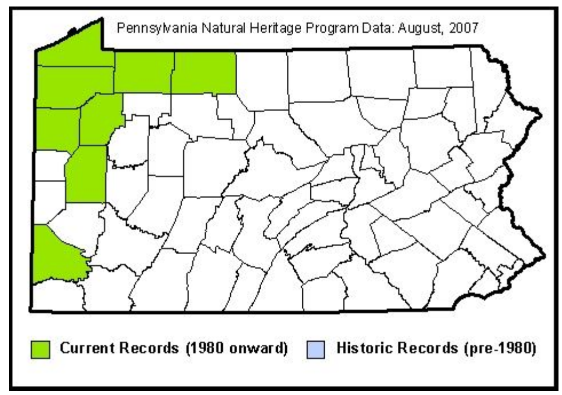
Lasmigona compressa lives in the Mississippi River basin from Kentucky north, as well as in the St. Lawrence basin, the Great Lakes basin, and the Hudson River basin (Strayer and Jirka 1997; www.natureserve.org/explorer). Additionally, *Lasmigona compressa* has been located in the northeastern headwaters of the Susquehanna River basin (Strayer and Jirka 1997). It is not well understood how this species migrated to these locations. The Pennsylvania proposed state status of the creek heelsplitter is condition rare (CR) due to a lack of individuals located during mussel surveys (www.naturalheritage.state.pa.us/invertebrates.aspx). Little is known about the status of freshwater mussels in Pennsylvania and the United States. Because of this, more surveys are required to determine the status of this species and other freshwater mussels in Pennsylvania.

The creek heelsplitter can be characterized by its compressed, trapezoidal shape, small dorsal wing, and large interdental tooth. However, it can be confused with *Lasmigona subviridis*. The latter species is smaller, more ovate, and has a significantly smaller interdental tooth. Additionally, its beak sculpture only has three to four smaller, less deeply curved double-looped bars that are distinctly nodulous. The beak sculpture of *Lasmigona compressa* consists of four to five large, deeply grooved double-looped bars of even height. Additionally, *Lasmigona compressa* is one of the few freshwater mussels that are hermaphroditic (Strayer and Jirka 1997).

North American State/Province Conservation Status

Map by NatureServe (2007)





Pennsylvania Natural Heritage Program

PENNSYLVANIA FISH & BOAT COMMISSION

References

National Park Service. U.S. Department of the Interior. Mississippi National River and Recreation Area. Website: www.nps.gov/miss/features/mussels/musselpages/creekheelsplitter.htmlNatureServe.

2007. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.2. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. (Accessed: August 31, 2007).

Pennsylvania Natural Heritage Program. Biota of Concern In Pennsylvania (BOCIP) Lists. Website: www.naturalheritage.state.pa.us/invertebrates.aspx

Sietman, B. E. 2003. Field Guide to the Freshwater Mussels of Minnesota. Department of Natural Resources, St. Paul, MN 140 pp.

Strayer, D.L. and K.J. Jirka. 1997. The Pearly Mussels of New York State. The New York State Education Dept., Albany, NY 113 pp and plates

Annex IV.A.6-F1.

Species List

McKean County State Species Types

To copy these items use ctrl-a, then you can paste into other applications like word processors, spreadsheets, etc.

Scientific Name	Common Name	Global Rank	State Rank	State Status	Proposed State Status	Federal Status
Carex wiegandii	Wiegands Sedge	G4	S1	PT	PT	
Gomphus descriptus	Harpoon Clubtail	G4	S1S2			
Accipiter gentilis	Northern Goshawk	G5	S2S3B,S3N		CR	
Aeshna tuberculifera	Black-tipped Darner	G4	S2S3			
Empidonax flaviventris	Yellow-bellied Flycatcher	G5	S1S2B	PE	PE	
Ophiogomphus mainensis	Maine Snaketail	G4	S3			
Phoxinus erythrogaster	Southern Redbelly Dace	G5	S1	PT	PT	
Sylvilagus obscurus	Appalachian Cottontail	G4	SU			
Lampsilis fasciola	Wavy-rayed Lampmussel	G5	S4		N	
Aeshna verticalis	Green-striped Darner	G5	S3S4			
Satyrodes eurydice	Eyed Brown	G4	S3			
Liochlorophis vernalis	Smooth Green Snake	G5	S3S4			
Viburnum trilobum	Highbush-cranberry	G5T5	S3S4	TU	PR	
Lanthus parvulus	Northern Pygmy Clubtail	G4	S3S4			
Calopteryx amata	Superb Jewelwing	G4	S2S3			
Gaultheria hispidula	Creeping Snowberry	G5	S3	PR	PR	
Ichthyomyzon bdellium	Ohio Lamprey	G3G4	S2S3	PC	CP	
Scirpus pedicellatus	Stalked Bulrush	G4	S1	PT	PT	
Ribes triste	Red Currant	G5	S2	PT	PT	
Catharus ustulatus	Swainson's Thrush	G5	S2S3B,S5N		CR	
Leucorrhinia	Red-waisted	G5	S2			

proxima	Whiteface					
Populus balsamifera	Balsam Poplar	G5	S1	PE	PE	
Lycaena hyllus	Bronze Copper	G5	S3			
Argia tibialis	Blue-tipped Dancer	G5	S1			
Amelanchier bartramiana	Oblong-fruited Serviceberry	G5	S1	PE	PE	
Percina copelandi	Channel Darter	G4	S2		PT	
High-gradient clearwater creek	High-gradient Clearwater Creek	GNR	S3			
Somatochlora elongata	Ski-tailed Emerald	G5	S2			
Parthenium integrifolium	American Fever-few	G5	S1	TU	PE	
Pleurobema sintoxia	Round Pigtoe	G4G5	S2		PE	
Crotalus horridus	Timber Rattlesnake	G4	S3S4	PC	CA	
Alisma triviale	Northern Water-plantain	G5	S1	PE	PE	
Glaucomys sabrinus	Northern Flying Squirrel	G5	SU	PE		
Gallinago delicata	Wilson's Snipe	G5	S3B,S3N		CR	
Ardea herodias	Great Blue Heron	G5	S3S4B,S4N			
Speyeria atlantis	Atlantis Fritillary	G5	S3			
Somatochlora forcipata	Forcipate Emerald	G5	S2			
Cordulia shurtleffi	American Emerald	G5	S3S4			
Chlosyne harrisii	Harris' Checkerspot	G4	S3			
Hesperia sassacus	Indian Skipper	G5	S3			
Somatochlora walshii	Brush-tipped Emerald	G5	S2			
Thamnophis brachystoma	Shorthead Garter Snake	G4	S3			
Carex ormostachya	Spike Sedge	G4	S2	N	PT	
Ichthyomyzon greeleyi	Mountain Brook Lamprey	G3G4	S2	PT	PT	
Filipendula						

rubra	Queen-of-the-prairie	G4G5	S1S2	TU	TU	
Boyeria grafiana	Ocellated Darner	G5	S3			
Myotis septentrionalis	Northern Myotis	G4	S3B,S3N		CR	
Haliaeetus leucocephalus	Bald Eagle	G5	S2B	PT	PT	
Lasionycteris noctivagans	Silver-haired Bat	G5	SUB		CR	
Hesperia leonardus	Leonard's Skipper	G4	S3			
Sorex palustris albibarbis	Water Shrew	G5T5	S3		CR	
Spiranthes casei	Case's Ladies'-tresses	G4	S1	PE	PE	
Stylurus scudderi	Zebra Clubtail	G4	S1			
Epilobium strictum	Downy Willow-herb	G5?	S3	PE	PR	
Pandion haliaetus	Osprey	G5	S2B	PT	PT	
Boloria selene myrina	Silver Bordered Fritillary	G5T5	S3			
Viola selkirkii	Great-spurred Violet	G5?	S3S4	N	PR	
Lota lota	Burbot	G5	S1S2	PE	PE	
Juncus filiformis	Thread Rush	G5	S3	PR	PR	
Streptopus amplexifolius	White Twisted-stalk	G5	S1	PT	PE	
Cardamine maxima	Large Toothwort	G5	S2	N	PT	
Hemlock (white pine) - northern hardwood forest		GNR	S5			
Lampetra appendix	American Brook Lamprey	G4	S3	PC	CP	
Lasmigona compressa	Creek Heelsplitter	G5	S2S3		CR	
Alasmidonta marginata	Elktoe	G4	S4		N	
Sympetrum obtrusum	White-faced Meadowhawk	G5	S3S4			
Carex careyana	Carey's Sedge	G4G5	S1	PE	PE	

Red spruce palustrine forest		GNR	S3			
Erosional remnant	Erosional Remnant	GNR	SNR			
Percina macrocephala	Longhead Darter	G3	S2S3		PT	
Notropis dorsalis	Bigmouth Shiner	G5	S2	PT	PT	
Fusconaia subrotunda	Long-solid	G3	S1		PE	
Leucorrhinia glacialis	Crimson-ringed Whiteface	G5	S3S4			
Eumeces anthracinus	Coal Skink	G5	S3			

Annex IV.A.6-F2.

Fresh Water Mussels (Elktoe)

Elktoe (Alasmidonta marginata)

Freshwater Mussel Species of Concern

State Rank: S4 (apparently secure), **Global Rank: G4** (apparently secure)

Identification

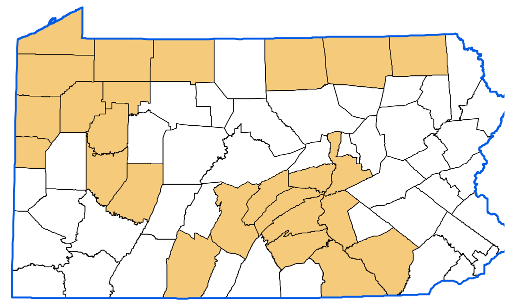
The Elktoe (*Alasmidonta marginata*) is a moderately sized mussel, commonly reaching 75 mm in length. The shell is trapezoidal or rhomboid shaped, inflated, and thin (Parmalee 1998, Strayer and Jirka 1997). The anterior margin is rounded, with a somewhat straight ventral margin. The ventral and posterior margins meet in a blunt, squared point (Parmalee 1998). The posterior ridge is the focal point of the shell and is sharply angled. The posterior slope is flattened with fine, well-developed ridges crossing the growth lines. The beaks are high, inflated, and are comprised of three to four heavy double-looped ridges. The periostracum (outer covering) is usually yellowish or greenish, with green rays and darker spots that may appear connected to the rays (rays may appear interrupted). Lateral teeth are vestigial and appear as nothing more than indistinct bumps along the hinge line. The nacre (inner iridescent coloring) is usually bluish-white (Parmalee 1998; Sietman 2003; Strayer and Jirka 1997).

Photo: http://www.lwatrous.com/missouri_mollusks/mussels/images/a_marginata.jpg

Habitat

The Elktoe can be found in medium to large size streams, but is most common in smaller streams. This species is present in greatest abundance in small shallow rivers with a moderately fast current and riffles. The preferred substrate is fine gravel mixed with sand (Parmalee 1998; Sietman 2003; Strayer and Jirka 1997; NatureServe 2005).

Pennsylvania Distribution by County



Pennsylvania Natural Heritage Program data 2007

Host Fish

Hosts for Elktoe glochidia include the white sucker, northern hogsucker, shorthead redhorse, rockbass, and warmouth (Parmalee 1998; Strayer and Jirka 1997).

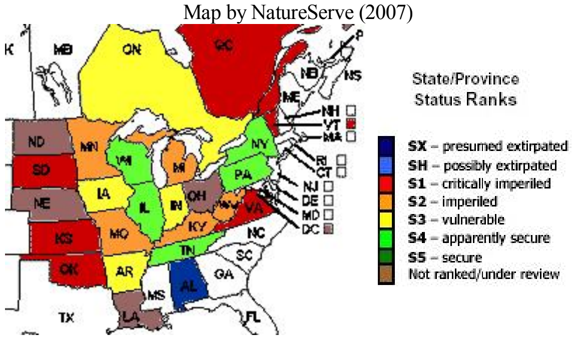
Status

Populations of *Alasmidonta marginata* can be found from Ontario, Canada to Alabama. Its eastern boundary ranges along the east coast from New York to Virginia and the western boundary ranges from North Dakota to Oklahoma. Most populations are located in Ohio, Indiana, and Illinois. This mussel is thought to have been extirpated from Alabama since it has not been reported during surveys for several decades (NatureServe 2005; Parmalee 1998; Strayer and Jirka 1997). This species is not common in Pennsylvania but has been found in the Susquehanna River and Ohio drainages. The proposed state status of the Elktoe is not ranked (N), meaning there is insufficient data available to provide an adequate basis for assignment to specific categories concerning the security of known populations (PNHP). The state rank of this species suggests it is secure at some sites within Pennsylvania state boundaries. However, more surveys are required to determine the status of this species and other freshwater mussels in Pennsylvania.

Alasmidonta marginata is typically thought of as an interior basin species. It is not well understood how *Alasmidonta marginata* reached the Susquehanna River basin from its native range. Some researchers believe it may have drifted from the Allegheny River basin to Susquehanna via postglacial influences. An alternative theory states this species was introduced to the Susquehanna River basin via human activity (Strayer and Jirka 1997).

North American State/Province Conservation Status

Map by NatureServe (2007)



References

NatureServe. 2007. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.2. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. (Accessed: September 4, 2007).

Parmalee, P.W. and Bogan, A.E. 1998. The Freshwater Mussels of Tennessee. The University of Tennessee, Knoxville, TN 328 pp.

Pennsylvania Natural Heritage Program. Biota of Concern In Pennsylvania (BOCIP) Lists. Website: www.naturalheritage.state.pa.us/invertebrates.aspx

Sietman, B.E. 2003. Field Guide to the Freshwater Mussels of Minnesota. Minnesota Department of Natural Resources, St. Paul, MN 140 pp.

Strayer, D.L. and K.J. Jirka. 1997. The Pearly Mussels of New York State. The New York State Education Dept., Albany, N.Y. 113 pp and plate

PNHP
Pennsylvania Natural Heritage Program

PENNSYLVANIA FISH & BOAT COMMISSION

Annex IV.A.6-F3.

Fresh Water Mussels (Creek Heelsplitter)

Creek Heelsplitter
Lasmigona compressa

Freshwater Mussel Species of Concern

State Rank: S2S3 Global Rank: G5

Identification

The creek heelsplitter (*Lasmigona compressa*) is a moderately sized mussel, usually less than 100 mm in length. The shell is subtrapeziodal in shape, compressed, and moderately thick. Juvenile specimens can sometimes have a small dorsal wing (Strayer and Jirka 1997). The periostracum (outer covering) is somewhat smooth and varies from greenish (juvenile) to greenish-black (adult), sometimes with fine green rays (usually apparent in young individuals). The beak sculpture is obvious and double-looped (Sietman 2003; Strayer and Jirka 1997). Pseudocardinal teeth are present but are usually smooth and lamellar (reduced). Lateral teeth are delicate, but functional and interlocking. There is a prominent interdental tooth in the left valve between the lateral teeth and pseudocardinal teeth (Strayer and Jirka 1997). The nacre (inner iridescent coloring) is usually white, but can be cream or salmon colored (especially toward the beak cavity) (Sietman 2003; Strayer and Jirka 1997).

www.darbycreeks.org/creekheelsplitterLittleDarby72.jpg

Habitat

The creek heelsplitter is typically located in creeks, but can sometimes be observed in streams too small to adequately support other species of freshwater mussels (Strayer and Jirka 1997). It is most commonly found in headwaters of small or medium rivers in fine gravel or sand (Sietman 2003; www.nps.gov/miss/features/mussels/musselpages/creekheelsplitter.html).

Photo: PA Science Office TNC

Photo: PA Science Office TNC

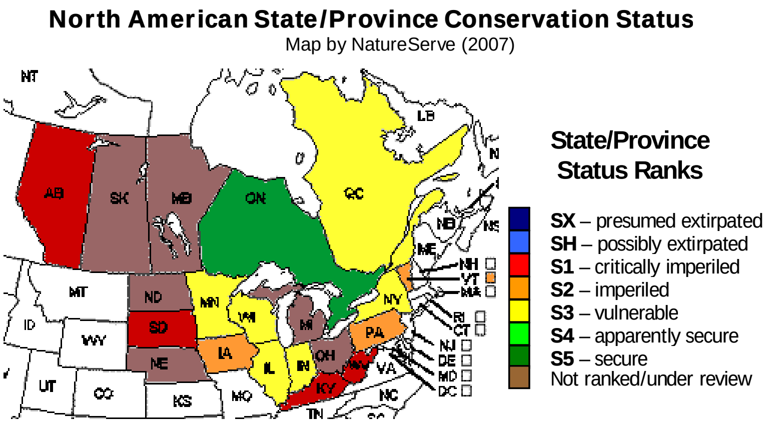
Host Fish

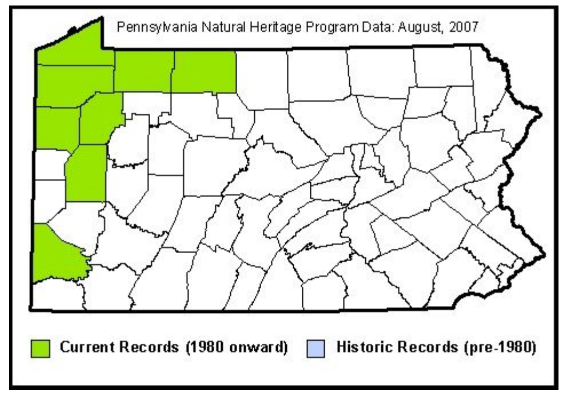
Suitable host fish for the creek heelsplitter include the slimy sculpin, spotfin shiner, black crappie, and the yellow perch (Strayer and Jirka 1997; www.nps.gov/miss/features/mussels/musselpages/creekheelsplitter.html).

Status

Lasmigona compressa lives in the Mississippi River basin from Kentucky north, as well as in the St. Lawrence basin, the Great Lakes basin, and the Hudson River basin (Strayer and Jirka 1997; www.natureserve.org/explorer). Additionally, *Lasmigona compressa* has been located in the northeastern headwaters of the Susquehanna River basin (Strayer and Jirka 1997). It is not well understood how this species migrated to these locations. The Pennsylvania proposed state status of the creek heelsplitter is condition rare (CR) due to a lack of individuals located during mussel surveys (www.naturalheritage.state.pa.us/invertebrates.aspx). Little is known about the status of freshwater mussels in Pennsylvania and the United States. Because of this, more surveys are required to determine the status of this species and other freshwater mussels in Pennsylvania.

The creek heelsplitter can be characterized by its compressed, trapezoidal shape, small dorsal wing, and large interdental tooth. However, it can be confused with *Lasmigona subviridis*. The latter species is smaller, more ovate, and has a significantly smaller interdental tooth. Additionally, its beak sculpture only has three to four smaller, less deeply curved double-looped bars that are distinctly nodulous. The beak sculpture of *Lasmigona compressa* consists of four to five large, deeply grooved double-looped bars of even height. Additionally, *Lasmigona compressa* is one of the few freshwater mussels that are hermaphroditic (Strayer and Jirka 1997).





Pennsylvania Natural Heritage Program

PENNSYLVANIA FISH & BOAT COMMISSION

References

National Park Service. U.S. Department of the Interior. Mississippi National River and Recreation Area. Website: www.nps.gov/miss/features/mussels/musselpages/creekheelsplitter.htmlNatureServe. 2007. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.2. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. (Accessed: August 31, 2007).

Pennsylvania Natural Heritage Program. Biota of Concern In Pennsylvania (BOCIP) Lists. Website: www.naturalheritage.state.pa.us/invertebrates.aspx

Sietman, B. E. 2003. Field Guide to the Freshwater Mussels of Minnesota. Department of Natural Resources, St. Paul, MN 140 pp.

Strayer, D.L. and K.J. Jirka. 1997. The Pearly Mussels of New York State. The New York State Education Dept., Albany, NY 113 pp and plates

Annex IV.A.6-G1.

ER Submission

Pennsylvania Historical & Museum Commission
Bureau for Historic Preservation

BHP Use Only
ER #

Request to Initiate Consultation in Compliance with the State History Code and Section 106 of the National Historic Preservation Act

Applicant Information (print neatly, this will be used in the return envelope)

Applicant Name ______________________
Street Address ______________________
City ______________ Phone Number ______________
State/ZIP

Contact Person to Receive Response (if applicable) (print neatly, this will be used in the return envelope)

Name/Company ______________________
Street Address ______________________
City ______________ Phone Number ______________
State/ZIP

Project Information

Project Title ______________________

Project Location and/address ______________________

Municipality ______________ **County Name** ______________

If this project was ever reviewed before, include previous ER #

Project Type (Check all that apply)

Government Funded/Sponsored or On Government Land?
☐ **Yes** ☐ **No** **Specify Agency and/or Program Name Below**

State Agency: ______________ Local: ______________
Federal Agency: ______________ Other: ______________

Permits or Approvals Required
☐ **Yes** ☐ **No** **Specify Agency and/or Program Name Below**

Anticipated Permits:
State Agency: ______________ Program: ______________
Federal Agency: ______________ Program: ______________

Agency Office to Receive Response (Check all that apply)

Army Corps of Engineers: ☐ Philadelphia ☐ Baltimore ☐ Pittsburgh
DEP Office: ☐ Central Office ☐ Regional Office: ______________
☐ District Mining Office: ______________ ☐ Oil & Gas Office: ______________
☐ Other: (provide address)

Pennsylvania Historical & Museum Commission
Bureau for Historic Preservation

BHP Use Only
ER #

Required Project Information for BHP/SHPO Review

☐ Total Acres in the property under review: ______________________

☐ Total acres of earth disturbance for this proposed activity: ______________________

☐ Are there any buildings or structures within the project area? ☐ Yes ☐ No

Approximate age of buildings:

☐ Project located in or adjacent to a historic district? ☐ Yes ☐ No ☐ Unsure

Name of Historic District ______________________

Submissions Must Also Include:

☐ MAP LOCATION: A 7.5 USGS Map showing the project boundary and the Area of Potential Effect (APE). The APE should include indirect effects, such as visual and audible impacts. Federal Projects must provide an explanation of how the APE was determined.

☐ PHOTOS: Photos of all buildings or structures in the APE over 50 years old. If the property is over 50 years old submit a Historic Resource Form with this initial request. The forms are available at http://www.phmc.state.pa.us/bhp/inventories.

☐ PROJECT DESCRIPTION NARRATIVE: Provide a detailed project description describing the project, any ground disturbance, any previous land use, and age of all effected buildings in the project area. Attach a site map showing the location of all buildings in the project area.

☐ I have reviewed all DEP Permit Exemptions listed on the DEP website www.dep.state.pa.us.

In addition, federal agencies must provide:

☐ Measures that will be taken to identify consulting parties including Native Americans.

☐ Measures that will be taken to notify and involve the public.

The information on this form is needed to determine whether potential historic or archaeological resources are present. Additional historic information or investigation may be requested to determine the significance of the resources or the effects of the project on those resources. ***Form and attachments must be submitted by mail. Submissions via e-mail will not be accepted.***

Signature Block

Applicant's Signature   Date

Please Print and Mail Completed Form and Required Information to:

PA Historical & Museum Commission
Bureau for Historic Preservation
400 North Street
Commonwealth Keystone Building 2nd Floor
Harrisburg, PA 17120-0093

Annex IV.A.6-G2.

Archaeological Record of Disturbance

Pennsylvania Historical & Museum Commission
Bureau for Historic Preservation • State Historic Preservation Office

Record of Disturbance Form

ER#____________________

DATE 11/27/2009

(submit after initial field view, Phase IA Investigation, or Phase I Investigation)

1. Project Identification:

ER Number ______

Project Name &/or Agency Tracking #: _____

Agency: _____ **Applicant:** _____

Preparers Name and affiliation: _____

Date Prepared: _____

Project Area County/Municipality (list all)

County	Municipality

2. Project Setting: (check all that apply)

☐ urban/suburban; ☐ rural
☐ upland; ☐ floodplain/terrace (☐active; ☐stable terrace)

7.5″ USGS Quadrangle(s) Name (list all):

Name	Date

Physiographic Zone(s)(list All. Use DCNR Map 13 compiled by W.D. Sevon, Fourth Edition, 2000.):

Physiographic Zone

Project Area Drainage(s), (list all) (Sub-basin and Watershed can be obtained from CRGIS):

Sub-basin	Watershed	Major Stream	Minor Stream

3. Basic Field Conditions:

(Text fields will expand as needed. Please be complete)

Area of APE / Project Area in hectares:______ Hectares tested: ______

General Description of APE / Project Area: ______

Type of Proposed Project / Impact: ______

Date of field investigation(s): ______

Description of Field Conditions and Disturbance:

4 Methodology Used to Determine Disturbance: (check all that apply; attach any supporting documents)

☐ PASS file Research ☐ Contacted Local Historical Association/Commission/Park/Etc.

- ☐ Informant Data
- ☐ Surface Survey
- ☐ Test Units
- ☐ Historic Records/Maps/Photos
- ☐ Geomorphological Borings
- ☐ Geomorphological Trenches
- ☐ SCS Soil Maps
- ☐ STPs
- ☐ Remote Sensing

Other: ______

Professional Geomorphologist was ☐Present or ☐ Not Present During Field Investigations

Name: ______ Affiliation: ______

Formal Geomorphological Report Prepared: ☐ Yes ☐ No

5. Previously Recorded Archaeological Sites within APE / Project Area:

PASS Site Number	Particular disturbance in this area

6. Required Attachments:

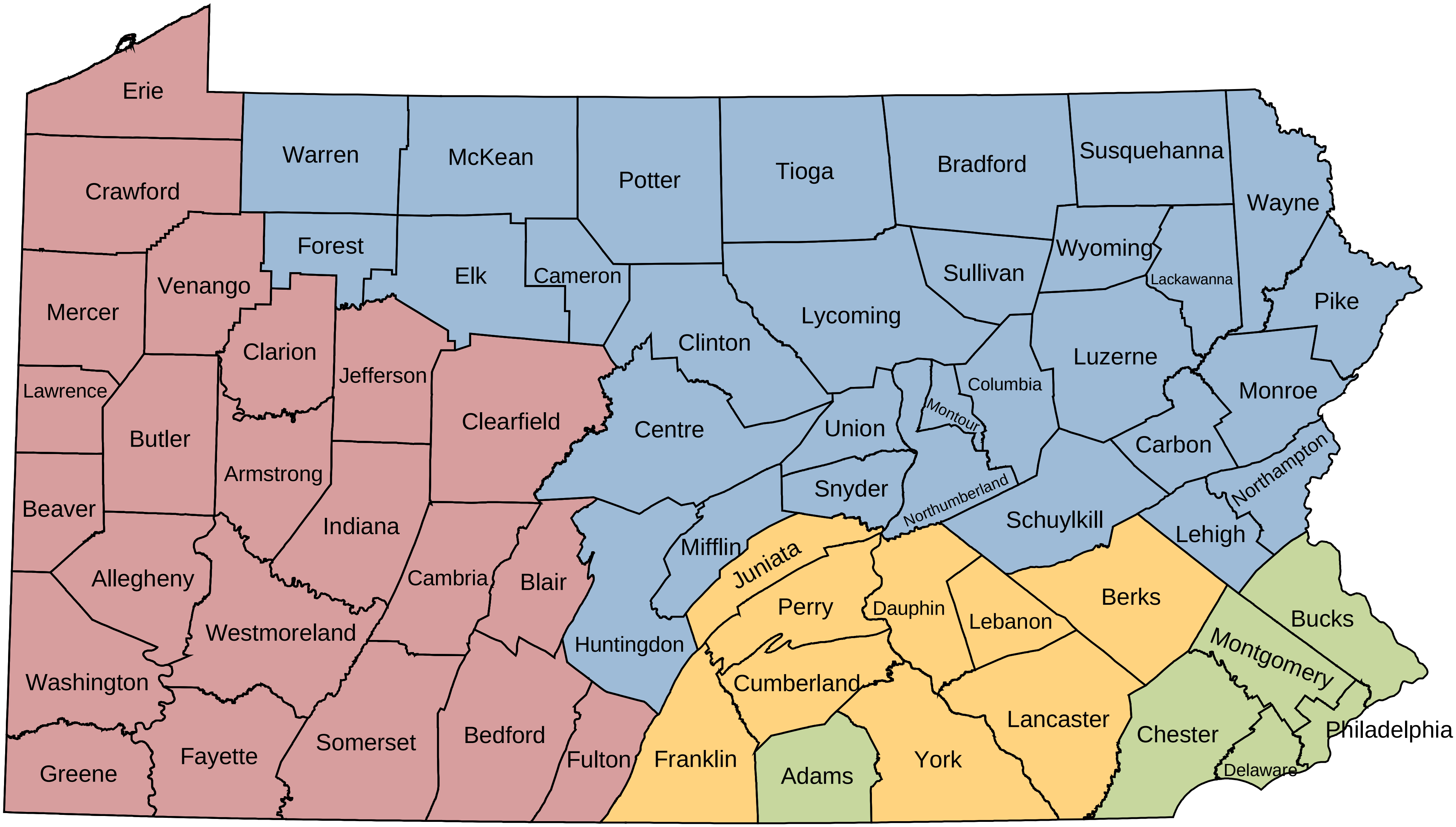
- ☐ 7.5′ USGS Quadrangle Map delineating APE / Project Area
- ☐ APE map showing location of any test units &/or orientation of photographs
- ☐ At least two (2) supporting photographs with descriptions of view and view direction
- ☐ Engineering / Project Plans if prepared
- ☐ Geomorphological Report if prepared
- ☐ Representative excavation profiles and descriptions

List all other attachments to this Record of Disturbance Form:

Attachment Type

Annex IV.A.6-G3.

Archaeological Review Map



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Steve McDougal (717) 772-0923 smcdougal@state.pa.us

Kira Presler (717) 705-0700 kpresler@state.pa.us

PHMC

Pennsylvania Historical & Museum Commission

Archaeological Review Regions

Bureau for Historic Preservation
Phone (717) 783-8946
Fax (717) 772-0920

Annex IV.A.6-H.

Permitting Schedule

SMETHPORT, PA DISTRICT HEATING
POTENTIAL RIGHT-TO-BUILD PERMITS, APPROVALS & REVIEWS

ID	Task Name	Duration
1	**Site No. 1**	**180 days**
2	Air Quality Plan Approval/Operating Permit (PADEP)	180 days
3	Storage Tank Registrations/Permitting (PADEP)	90 days
4	NPDES General or Individual Permit (Construction)	180 days
5	Act 537 Sewage Facilities Planning	44 days
6	Beneficial Use Permits	60 days
7	Highway Work Permit	90 days
8	Site Plan/Subdivision Approvals	90 days
9	**Site No. 2**	**231 days**
10	Section 404 Permit (USACE)	180 days
11	Section 401 WQ Certification (PADEP)	1 day
12	Water Obst. & Encr. Permit (PADEP)	160 days
13	Air Quality Plan Approval/Operating Permit (PADEP)	180 days
14	Storage Tank Registrations/Permitting (PADEP)	90 days
15	NPDES General or Individual Permit (Construction)	180 days
16	Act 537 Sewage Facilities Planning	44 days
17	Beneficial Use Permits	60 days
18	Highway Work Permit	90 days
19	Site Plan/Subdivision Approvals	90 days
20	Floodplain Development Permit	90 days
21	**Site No. 3**	**180 days**
22	Air Quality Plan Approval/Operating Permit (PADEP)	180 days
23	Storage Tank Registrations/Permitting (PADEP)	90 days
24	NPDES General or Individual Permit (Construction)	180 days
25	Act 537 Sewage Facilities Planning	44 days
26	Beneficial Use Permits	60 days
27	Highway Work Permit	90 days
28	Site Plan Approval	90 days

Project: Permitting Schedule.mpp
Date: Thu 11/12/09

Task | Split | Progress | Milestone | Summary | Project Summary | External Tasks | External Milestone | Deadline

SMETHPORT, PA DISTRICT HEATING
POTENTIAL RIGHT-TO-BUILD PERMITS, APPROVALS & REVIEWS

1 Site No. 1
Regulatory review timeframes estimated based on "Guide to DEP Permits and Other Authorizations." Start date represents submission of application package to reviewing agency. PADEP permit timeframes include 30-day preparation of "Response to Deficiency Letter." Authorization under General Permits will shorten timeframes for certain permits (*i.e.,* NPDES General Permit for Storm Water Discharges Associated with Construction Activities), but will not impact overall schedule influenced by critical path permits (*i.e.*, Air Quality Plan Approval/Operating Permit).

2 Air Quality Plan Approval/Operating Permit (PADEP)
Consultations with PA Historical & Museum Commission (Cultural Resource Notice) and PA Natural Diversity Inventory (PNDI) will be concurrent with PADEP permit review process.

13 Air Quality Plan Approval/Operating Permit (PADEP)
Consultations with PA Historical & Museum Commission (Cultural Resource Notice) and PA Natural Diversity Inventory (PNDI) will be concurrent with PADEP permit review process.

19 Site Plan/Subdivision Approvals
It is assumed that development of Site no. 2 will result in encroachments on federal wetlands requiring review and approval by the USSACE. It is also assumed that the site plan layout will not be finalized for approval by the municipality until the USACE has indicated that such layout is the "Least Environmentally-Damaging Practicable Alternative" (LEDPA). Consequently, site plan approval (and the concurrent floodplain development permit review) would not be completed until after issuance of the LEDPA, and perhaps the USACE permit.

22 Air Quality Plan Approval/Operating Permit (PADEP)
Consultations with PA Historical & Museum Commission (Cultural Resource Notice) and PA Natural Diversity Inventory (PNDI) will be concurrent with PADEP permit review process.

Annex IV.A.8-A

Investment Costs

Annex IV.A.8-A
Investment Costs

INVESTMENT COSTS

BIOMASS POWER PLANT

Technology			USD
a	separator for impurities		0
b	fuel storage and transport		974.978
c	furnace and boiler		9.082.294
d	flue gas cleaning (electrostatic precipitator)		907.479
e	emmission measurement		149.997
f	flue gas discharge		97.498
g	water treatment		224.995
h	power generation		4.274.903
i	vacuum condenser		2.759.938
j	heat exchanger/cooler		0
k	piping and heating distribution		1.349.969
l	switchgear, transformerm cabeling (Costs vom Seeger replaced by costs from OBG)*		0
m	process contropl engineering		224.995
n	compressed air generation		59.999
o	crane (turbine house)		52.499
p	fire extinguishing installation		74.998
q	building services		224.995
r	wheel loader		239.995
s	biomass hot water boiler		0
t	gas-fired peak load boiler		374.992
u	truck weigh station		52.499
v	emergency power supply		59.999
w	heat grid		0
x	transfer station		0
y	truck dumper		1.049.976
Total technology			**22.236.997**
Real estate			**0**
1	real estate costs		200.000
2	development costs		0
Total real estate			**200.000**
Construction			**0**
1	buildings		3.749.915
2	civil engineering + outside facilities (Costs vom Seeger replaced by costs from OBG)*		925.000
3	Utilities (Costs vom Seeger replaced by costs from OBG)*		850.360
Total construction			**5.525.275**
Engineering Services			
1	architect and engineering services		1.664.962
2	Design and Construction Management Services (costs from OBG)		177.536
3	Contingency Allowance (costs from OBG)		177.536
4			
5			
Total engineering services			**2.020.034**
subtotal			**29.982.306**
Contingencies		2,50%	**749.558**
Total Invest Biomass Plant			**30.731.864**

District Heating Network

1.1 Technology		USD
	pipework	11.909.591
	excavation costs	7.855.589
	DHW charging system	2.370.160

Annex IV.A.8-A
Investment Costs

	customer interface (compact station)		3.394.180
	Pumps		538.500
	pressure maintenance		112.200
Total technology			**26.180.220**
1.2 Real estate			
1	real estate costs		0
2	development costs		0
Total real estate			**0**
1.3 Construction			
1	buildings		0
2	outside facilities		0
3	civil engineering		0
Total construction			**0**
1.4 Engineering Services			
1	10% of technology invest		2.618.022
			0
			0
			0
Total engineering services			**2.618.022**
subtotal			**28.798.242**
Contingencies		2,50%	**719.956**
Total Investment District Heating			**29.518.198**
Total Investment			**60.250.062**

* For changes see Annex IV.A.5 - Draft Cost Estimate.pdf

Annex IV.A.8-B

Input Data

Annex IV.A.8-B
Input Data

date	02.12.2009	
status	**DRAFT**	

Legend

Input field
to be clarified
changed items

Time Assumptions

Project start	2011	
Project lifetime	30	
End of project	2041	

ECONOMICS

Currency

	fx rate	
reference currency	EUR	0,6667
project currency	USD	1,5000

Subsidies

Production Tax Credit (PTC)	☐
Investment Tax Credit	☐
Cash grant	☑

Taxation (corporate tax rate)	0,00%	
SCF	1	
Domestic Inflation rate	0,0%	
WACC	6,84%	
Power feed-in tariff	0,13	USD/kWh
Heat price	0,08	USD/kWh
Price per REC	0	USD
Fuel type	Wood Chips	
Specific fuel costs	35,00	USD/t
Fossil fuel savings	3.943	l/a
Fossil fuel price	0	USD/l
specific costs of ash disposal	45,00	USD/t
specific costs of water treatment	6,00	USD/m³
Average wages	60.000	USD/a employee

Annex IV.A.8-B
Input Data

TECHNOLOGY

BIOMASS POWER PLANT

TERMS		
COD year	2011	
COD quater	2	
COD date	01.07.2011	
Percentage of 1st year	50%	
Useful lifetime	15	
Major Overhaul	100%	
Intevall	15	years
Year of Major Overhaul	2026	
Major Overhaul Amount	22.236.997	
Major Overhaul Reserve	1.482.466	
Features		
Redundant boiler	760	h/a
Generation		
Power		
Average el. capacity	4.900	kW_{el}
Operating hours	8.000	h/a
Annual power generation	39.200.000	$kW_{el}h/a$
Heat		
Average heat capacity	3740	kW_{th}
Annual heat generation	29.920.000	$kW_{th}h/a$
Supply		
Power		
Average power supply capacity	600	kW
Specific electricity costs	0,08	USD/kWh
Fuel		
Average fuel power input	20.600	kW
Average calorific value of fuel	2.300	kWh/t
Ash		
annual amount of ash	3.587	t/a
Water		
annual amount treated per hour	2,5	m^3/h

Annex IV.A.8-B
Input Data

Peak Load/ redundancy covering		
annual heat capacity of fuel	3.500	MWh/a
specific costs of heat capcity	40,00	USD/MWh
O&M		
Major Overhaul BMPP	22.236.997	USD
Operating supplies	37.500	USD
Service costs as of % of investment	0,30%	
annual escalation	*0,00%*	
personnel requirement	8	employees
Admin		
management	0	USD/a
insurance	0	USD/a

District Heating Network

Operation & maintenance	296.500	USD/a
Power consumption pumps	22.525	USD/a
Water losses net	4.106	USD/a

PROJECT COSTS

for details refer to: CAPEX

Biomass Power Plant	**30.731.864**
Technology	22.236.997
Real estate	200.000
Construction	5.525.275
Engineering Services	2.020.034
Contingencies	749.558
District Heating Network	**29.518.198**
Technology	26.180.220
Real estate	0
Construction	0
Engineering Services	2.618.022
Contingencies	719.956
TOTAL CAPEX	**60.250.062**

DEPRECIATION ON ASSETS

for details refer to: DEP

Biomass Power Plant

depreciation type	linear	
recovery period	15	years
depreciable amount	22.236.997	USD
depreciation amount	1.482.466	USD

District Heating Network

depreciation type	linear	
recovery period	30	years
depreciable amount	26.180.220	USD
depreciable amount	872.674	USD

Annex IV.A.8-B
Input Data

FINANCING	
for details refer to:	FIN
Loans	

Biomass Power Plant

Stucture

CAPEX plus fees & charges	31.338.133 USD
Subsidies	14.719.559 USD
Total amount to be financed	16.618.574 USD
Bonds	0 USD
Senior loan A	11.633.002 USD
Equity	4.985.572 USD

Debt terms

Interest	6,00%
Payout	100%
Draw down	1-Jan-12
Grace period	2 years
Loan life	15 years
Number of installment	4 per year
Annuity	391.387 USD

District Heating Network

Stucture

CAPEX plus fees & charges	30.576.881 USD
Subsidies	8.855.459 USD
Total amount to be financed	21.721.421 USD
Equity	6.516.426 USD
Senior loan B	15.204.995 USD

Debt terms

Interest	6,00%
Payout	100%
Draw down	1-Jan-12
Grace period	2 years
Loan life	15 years
Number of installment	4 per year
Annuity	391.387 USD

Senior loan A	11.633.002
Senior loan B	15.204.995
Total loan volume	26.837.997

Annex IV.A.8-B
Input Data

Bonds

	Interest	USD	%
Partner bond A	0%	0	#DIV/0!
Partner bond B	0%	0	#DIV/0!
Partner bond C	0%	0	#DIV/0!
Total bond volume		0	#DIV/0!

SUMMARY

	USD	%
Loans	26.837.997	70%
Bonds	0	0%
Equity	11.501.999	30%
Total amount to be financed	38.339.996	100%
Leverage	70%	

Annex IV.A.8-C

OPERATIONAL REVENUES AND COSTS

Annex IV.A.8-C OPERATIONAL REVENUES AND COSTS

OPERATIONAL REVENUES AND COSTS

No.	Item	Value	Unit	1	2	3	4	5	6	7	8	9
	Revenues											
			year	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*
			workload	50%	100%	100%	100%	100%	100%	100%	100%	100%
	Power feed-in											
	average capacity	4.900	kW_{el}	2.443	4.900	4.900	4.900	4.900	4.900	4.900	4.900	4.900
	annual power generation	39.200.000	kWh/a	19.546.301	39.200.000	39.200.000	39.200.000	39.200.000	39.200.000	39.200.000	39.200.000	39.200.000
	Power feed-in tariff	0,1300	USD/kWh	0	0	0	0	0	0	0	0	0
	revenues from power feed-in tariff	**5.096.000**	**USD**	**2.541.019**	**5.096.000**	**5.096.000**	**5.096.000**	**5.096.000**	**5.096.000**	**5.096.000**	**5.096.000**	**5.096.000**
	Heat sale											
	average capacity	3740	kW_{th}	1.865	3.740	3.740	3.740	3.740	3.740	3.740	3.740	3.740
	annual heat supply	32.762.400	kWh/a	16.336.320	32.762.400	32.762.400	32.762.400	32.762.400	32.762.400	32.762.400	32.762.400	32.762.400
	heat price	0,08	USD/kWh	0	0	0	0	0	0	0	0	0
	revenues from heat sale	**2.723.186**	**USD**	**1.357.863**	**2.723.186**	**2.723.186**	**2.723.186**	**2.723.186**	**2.723.186**	**2.723.186**	**2.723.186**	**2.723.186**
4	**Cost of Sales**											
4.1	**Consumption bound VDI 2067**	**verbrauchsgebunden**										
	operating hours CHP	8.000	h/a	3.989	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000
	average fuel power input	20.600	kW	20.600	20.600	20.600	20.600	20.600	20.600	20.600	20.600	20.600
	annual fuel energy	164.800.000	kWh/a	82.174.247	164.800.000	164.800.000	164.800.000	164.800.000	164.800.000	164.800.000	164.800.000	164.800.000
	redundant boiler	760	h/a	379	760	760	760	760	760	760	760	760
4.1.1	**Fuel supply**											
	average calorific value of fuel	2.300	kWh/t									
	required amount of fuel	71.652	t/a	35.728	71.652	71.652	71.652	71.652	71.652	71.652	71.652	71.652
	specific fuel costs	35,00	USD/t	35	35	35	35	35	35	35	35	35
	costs of fuel supply	**2.507.826**	**USD/t**	**1.250.478**	**2.507.826**	**2.507.826**	**2.507.826**	**2.507.826**	**2.507.826**	**2.507.826**	**2.507.826**	**2.507.826**
4.1.2	**Power supply**											
	average capacity	600	kW	600	600	600	600	600	600	600	600	600
	annual power requirement	4.800.000	kWh/a	2.393.425	4.800.000	4.800.000	4.800.000	4.800.000	4.800.000	4.800.000	4.800.000	4.800.000
	specific electricity costs	0,08	USD/kWh	0,08	0,08	0,08	0,08	0,08	0,08	0,08	0,08	0,08
	costs of power supply	**384.000**	**USD/kWh**	**191.474**	**384.000**	**384.000**	**384.000**	**384.000**	**384.000**	**384.000**	**384.000**	**384.000**
4.1.3	**Ash disposal**											
	annual amount of ash	3587	t/a	1.789	3.587	3.587	3.587	3.587	3.587	3.587	3.587	3.587
	specific costs of ash disposal	45,00	USD/t	45	45	45	45	45	45	45	45	45
	costs of ash disposal	**161.415**	**EUR**	**80.486**	**161.415**	**161.415**	**161.415**	**161.415**	**161.415**	**161.415**	**161.415**	**161.415**
4.1.4	**Water Treatment**											
	annual amount treated per hour	2,5	m^3/h	3	3	3	3	3	3	3	3	3
	specific costs of water treatment	6,00	USD/m^3	6	6	6	6	6	6	6	6	6
	costs of water treatment	**120.000**	**USD/m^3**	**59.836**	**120.000**	**120.000**	**120.000**	**120.000**	**120.000**	**120.000**	**120.000**	**120.000**
4.1.5	**Peak Load/ redundancy covering**											
	annual heat capacity of fuel	3500	MWh/a	1.745	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500
	specific costs of heat capcity	40	USD/MWh	40,00409444	40,00409444	40,00409444	40,00409444	40,00409444	40,00409444	40,00409444	40,00409444	40,00409444
	costs of peak load/redundancy covering	**140.014**	**USD**	**69.815**	**140.014**	**140.014**	**140.014**	**140.014**	**140.014**	**140.014**	**140.014**	**140.014**
4.1.	**Major Overhaul BMPP**	**22.236.997**	**USD**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
4.1.	**Operating supplies**	**37.500**	**USD**	**18.699**	**37.500**	**37.500**	**37.500**	**37.500**	**37.500**	**37.500**	**37.500**	**37.500**
4.1.	**DHN O&M**											
	Operation & maintenance	296.500	USD/a	147.844	296.500	296.500	296.500	296.500	296.500	296.500	296.500	296.500
	Power consumption pumps	22.525	USD/a	11.232	22.525	22.525	22.525	22.525	22.525	22.525	22.525	22.525
	Water losses net	4.106	USD/a	2.048	4.106	4.106	4.106	4.106	4.106	4.106	4.106	4.106
	DHN O&M	**323.131**	**USD**	**161.123**	**323.131**	**323.131**	**323.131**	**323.131**	**323.131**	**323.131**	**323.131**	**323.131**
	Consumption bound			**1.831.911**	**3.673.887**	**3.673.887**	**3.673.887**	**3.673.887**	**3.673.887**	**3.673.887**	**3.673.887**	**3.673.887**
4.2	**Operational bound VDI 2067**	**bertiebsgebunden**										
4.2.1	**Salaries and wages**											
	personnel requirement	8	employees	8	8	8	8	8	8	8	8	8
	labor costs	60.000	USD/a employe	60.000	60.000	60.000	60.000	60.000	60.000	60.000	60.000	60.000
	operating costs	**480.000**	**USD**	**239.342**	**480.000**	**480.000**	**480.000**	**480.000**	**480.000**	**480.000**	**480.000**	**480.000**
4.2.2	**Service and maintenance**											
	specific costs as of % of investment	0,3%		0,30%	0,30%	0,30%	0,30%	0,30%	0,30%	0,30%	0,30%	0,30%
	annual escalation	0,0%										
	costs of service and maintenance		**USD**	**45.972**	**92.196**	**92.196**	**92.196**	**92.196**	**92.196**	**92.196**	**92.196**	**92.196**
4.2.3	**Miscellaneous**											
	management	0	USD/a	0	0	0	0	0	0	0	0	0
	insurance	0	USD/a	0	0	0	0	0	0	0	0	0
	total miscellaneous	**0**	**USD**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	Operational bound		**USD**	**285.314**	**572.196**	**572.196**	**572.196**	**572.196**	**572.196**	**572.196**	**572.196**	**572.196**
	Cost of Sales			2.117.225	4.246.082	4.246.082	4.246.082	4.246.082	4.246.082	4.246.082	4.246.082	4.246.082
	Operating Cash Flow		**USD**	**1.781.657**	**3.573.104**	**3.573.104**	**3.573.104**	**3.573.104**	**3.573.104**	**3.573.104**	**3.573.104**	**3.573.104**

Annex IV.A.8-C OPERATIONAL REVENUES AND COSTS

10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
2020	*2021*	*2022*	*2023*	*2024*	*2025*	*2026*	*2027*	*2028*	*2029*	*2030*	*2031*	*2032*	*2033*	*2034*
100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
4.900	4.900	4.900	4.900	4.900	4.900	4.900	4.900	4.900	4.900	4.900	4.900	4.900	4.900	4.900
39.200.000	39.200.000	39.200.000	39.200.000	39.200.000	39.200.000	39.200.000	39.200.000	39.200.000	39.200.000	39.200.000	39.200.000	39.200.000	39.200.000	39.200.000
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.096.000	**5.096.000**	**5.096.000**	**5.096.000**	**5.096.000**	**5.096.000**	**5.096.000**	**5.096.000**	**5.096.000**	**5.096.000**	**5.096.000**	**5.096.000**	**5.096.000**	**5.096.000**	**5.096.000**
3.740	3.740	3.740	3.740	3.740	3.740	3.740	3.740	3.740	3.740	3.740	3.740	3.740	3.740	3.740
32.762.400	32.762.400	32.762.400	32.762.400	32.762.400	32.762.400	32.762.400	32.762.400	32.762.400	32.762.400	32.762.400	32.762.400	32.762.400	32.762.400	32.762.400
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.723.186	**2.723.186**	**2.723.186**	**2.723.186**	**2.723.186**	**2.723.186**	**2.723.186**	**2.723.186**	**2.723.186**	**2.723.186**	**2.723.186**	**2.723.186**	**2.723.186**	**2.723.186**	**2.723.186**
8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000
20.600	20.600	20.600	20.600	20.600	20.600	20.600	20.600	20.600	20.600	20.600	20.600	20.600	20.600	20.600
164.800.000	164.800.000	164.800.000	164.800.000	164.800.000	164.800.000	164.800.000	164.800.000	164.800.000	164.800.000	164.800.000	164.800.000	164.800.000	164.800.000	164.800.000
760	760	760	760	760	760	760	760	760	760	760	760	760	760	760
71.652	71.652	71.652	71.652	71.652	71.652	71.652	71.652	71.652	71.652	71.652	71.652	71.652	71.652	71.652
35	35	35	35	35	35	35	35	35	35	35	35	35	35	35
2.507.826	**2.507.826**	**2.507.826**	**2.507.826**	**2.507.826**	**2.507.826**	**2.507.826**	**2.507.826**	**2.507.826**	**2.507.826**	**2.507.826**	**2.507.826**	**2.507.826**	**2.507.826**	**2.507.826**
600	600	600	600	600	600	600	600	600	600	600	600	600	600	600
4.800.000	4.800.000	4.800.000	4.800.000	4.800.000	4.800.000	4.800.000	4.800.000	4.800.000	4.800.000	4.800.000	4.800.000	4.800.000	4.800.000	4.800.000
0,08	0,08	0,08	0,08	0,08	0,08	0,08	0,08	0,08	0,08	0,08	0,08	0,08	0,08	0,08
384.000	**384.000**	**384.000**	**384.000**	**384.000**	**384.000**	**384.000**	**384.000**	**384.000**	**384.000**	**384.000**	**384.000**	**384.000**	**384.000**	**384.000**
3.587	3.587	3.587	3.587	3.587	3.587	3.587	3.587	3.587	3.587	3.587	3.587	3.587	3.587	3.587
45	45	45	45	45	45	45	45	45	45	45	45	45	45	45
161.415	**161.415**	**161.415**	**161.415**	**161.415**	**161.415**	**161.415**	**161.415**	**161.415**	**161.415**	**161.415**	**161.415**	**161.415**	**161.415**	**161.415**
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
120.000	**120.000**	**120.000**	**120.000**	**120.000**	**120.000**	**120.000**	**120.000**	**120.000**	**120.000**	**120.000**	**120.000**	**120.000**	**120.000**	**120.000**
3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500	3.500
40,00409444	40,00409444	40,00409444	40,00409444	40,00409444	40,00409444	40,00409444	40,0040944	40,0040944	40,0040944	40,0040944	40,0040944	40,0040944	40,0040944	40,0040944
140.014	**140.014**	**140.014**	**140.014**	**140.014**	**140.014**	**140.014**	**140.014**	**140.014**	**140.014**	**140.014**	**140.014**	**140.014**	**140.014**	**140.014**
0	**0**	**0**	**0**	**0**	**0**	**22.236.997**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
37.500	**37.500**	**37.500**	**37.500**	**37.500**	**37.500**	**37.500**	**37.500**	**37.500**	**37.500**	**37.500**	**37.500**	**37.500**	**37.500**	**37.500**
296.500	296.500	296.500	296.500	296.500	296.500	296.500	296.500	296.500	296.500	296.500	296.500	296.500	296.500	296.500
22.525	22.525	22.525	22.525	22.525	22.525	22.525	22.525	22.525	22.525	22.525	22.525	22.525	22.525	22.525
4.106	4.106	4.106	4.106	4.106	4.106	4.106	4.106	4.106	4.106	4.106	4.106	4.106	4.106	4.106
323.131	**323.131**	**323.131**	**323.131**	**323.131**	**323.131**	**323.131**	**323.131**	**323.131**	**323.131**	**323.131**	**323.131**	**323.131**	**323.131**	**323.131**
3.673.887	**3.673.887**	**3.673.887**	**3.673.887**	**3.673.887**	**3.673.887**	**25.910.883**	**3.673.887**	**3.673.887**	**3.673.887**	**3.673.887**	**3.673.887**	**3.673.887**	**3.673.887**	**3.673.887**
8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
60.000	60.000	60.000	60.000	60.000	60.000	60.000	60.000	60.000	60.000	60.000	60.000	60.000	60.000	60.000
480.000	**480.000**	**480.000**	**480.000**	**480.000**	**480.000**	**480.000**	**480.000**	**480.000**	**480.000**	**480.000**	**480.000**	**480.000**	**480.000**	**480.000**
0,30%	0,30%	0,30%	0,30%	0,30%	0,30%	0,30%	0,30%	0,30%	0,30%	0,30%	0,30%	0,30%	0,30%	0,30%
92.196	**92.196**	**92.196**	**92.196**	**92.196**	**92.196**	**92.196**	**92.196**	**92.196**	**92.196**	**92.196**	**92.196**	**92.196**	**92.196**	**92.196**
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
572.196	**572.196**	**572.196**	**572.196**	**572.196**	**572.196**	**572.196**	**572.196**	**572.196**	**572.196**	**572.196**	**572.196**	**572.196**	**572.196**	**572.196**
4.246.082	4.246.082	4.246.082	4.246.082	4.246.082	4.246.082	26.483.079	4.246.082	4.246.082	4.246.082	4.246.082	4.246.082	4.246.082	4.246.082	4.246.082
3.573.104	**3.573.104**	**3.573.104**	**3.573.104**	**3.573.104**	**3.573.104**	**-18.663.893**	**3.573.104**	**3.573.104**	**3.573.104**	**3.573.104**	**3.573.104**	**3.573.104**	**3.573.104**	**3.573.104**

Annex IV.A.8-C OPERATIONAL REVENUES AND COSTS

25	26	27	28	29	30	31
2035	*2036*	*2037*	*2038*	*2039*	*2040*	*2041*
100%	100%	100%	100%	100%	100%	50%
4.900	4.900	4.900	4.900	4.900	4.900	2.457
39.200.000	39.200.000	39.200.000	39.200.000	39.200.000	39.200.000	19.653.699
0	0	0	0	0	0	0
5.096.000	**5.096.000**	**5.096.000**	**5.096.000**	**5.096.000**	**5.096.000**	**2.554.981**
3.740	3.740	3.740	3.740	3.740	3.740	1.875
32.762.400	32.762.400	32.762.400	32.762.400	32.762.400	32.762.400	16.426.080
0	0	0	0	0	0	0
2.723.186	**2.723.186**	**2.723.186**	**2.723.186**	**2.723.186**	**2.723.186**	**1.365.324**
8.000	8.000	8.000	8.000	8.000	8.000	4.011
20.600	20.600	20.600	20.600	20.600	20.600	20.600
164.800.000	164.800.000	164.800.000	164.800.000	164.800.000	164.800.000	82.625.753
760	760	760	760	760	760	381
71.652	71.652	71.652	71.652	71.652	71.652	35.924
35	35	35	35	35	35	35
2.507.826	**2.507.826**	**2.507.826**	**2.507.826**	**2.507.826**	**2.507.826**	**1.257.348**
600	600	600	600	600	600	600
4.800.000	4.800.000	4.800.000	4.800.000	4.800.000	4.800.000	2.406.575
0,08	0,08	0,08	0,08	0,08	0,08	0,08
384.000	**384.000**	**384.000**	**384.000**	**384.000**	**384.000**	**192.526**
3.587	3.587	3.587	3.587	3.587	3.587	1.798
45	45	45	45	45	45	45
161.415	**161.415**	**161.415**	**161.415**	**161.415**	**161.415**	**80.929**
3	3	3	3	3	3	3
6	6	6	6	6	6	6
120.000	**120.000**	**120.000**	**120.000**	**120.000**	**120.000**	**60.164**
3.500	3.500	3.500	3.500	3.500	3.500	1.755
40,0040944	40,0040944	40,0040944	40,0040944	40,0040944	40,0040944	40,0040944
140.014	**140.014**	**140.014**	**140.014**	**140.014**	**140.014**	**70.199**
0	**0**	**0**	**0**	**0**	**0**	**0**
37.500	**37.500**	**37.500**	**37.500**	**37.500**	**37.500**	**18.801**
296.500	296.500	296.500	296.500	296.500	296.500	148.656
22.525	22.525	22.525	22.525	22.525	22.525	11.293
4.106	4.106	4.106	4.106	4.106	4.106	2.059
323.131	**323.131**	**323.131**	**323.131**	**323.131**	**323.131**	**162.008**
3.673.887	**3.673.887**	**3.673.887**	**3.673.887**	**3.673.887**	**3.673.887**	**1.841.976**
8	8	8	8	8	8	8
60.000	60.000	60.000	60.000	60.000	60.000	60.000
480.000	**480.000**	**480.000**	**480.000**	**480.000**	**480.000**	**240.658**
0,30%	0,30%	0,30%	0,30%	0,30%	0,30%	0,30%
92.196	**92.196**	**92.196**	**92.196**	**92.196**	**92.196**	**46.224**
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	**0**	**0**	**0**	**0**	**0**	**0**
572.196	**572.196**	**572.196**	**572.196**	**572.196**	**572.196**	**286.882**
4.246.082	4.246.082	4.246.082	4.246.082	4.246.082	4.246.082	2128857,68
3.573.104	**3.573.104**	**3.573.104**	**3.573.104**	**3.573.104**	**3.573.104**	**1.791.447**

Annex IV.A.8-D

CASH FLOW STATEMENT

Annex IV.A.8-D CASH FLOW STATEMENT

CASH FLOW STATEMENT

Units: USD

				2011	2012	2013	2014	2015	2016
	Start of Period			**1-Jul-11**	**1-Jan-12**	**1-Jan-13**	**1-Jan-14**	**1-Jan-15**	**1-Jan-16**
	End of Period		**1-Jan-11**	**31-Dec-11**	**31-Dec-12**	**31-Dec-13**	**31-Dec-14**	**31-Dec-15**	**31-Dec-16**
	Construction period			100,0%	0,0%	0,0%	0,0%	0,0%	0,0%
	Operational period			49,9%	100,0%	100,0%	100,0%	100,0%	100,0%
	Operational year			1	2	3	4	5	6
	End of period			**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
1	**Cashflow from Operating Activities**	**67.883.971**		**171.378**	**1.962.824**	**1.992.811**	**2.063.793**	**2.139.033**	**2.218.788**
1.1	**Cash Inflow**	**234.575.591**		**3.898.882**	**7.819.186**	**7.819.186**	**7.819.186**	**7.819.186**	**7.819.186**
1.1.1	***Sales***	***234.575.591***		***3.898.882***	***7.819.186***	***7.819.186***	***7.819.186***	***7.819.186***	***7.819.186***
1.1.1.1	Power feed-in	152.880.000		2.541.019	5.096.000	5.096.000	5.096.000	5.096.000	5.096.000
1.1.1.2	Heat sale	81.695.591		1.357.863	2.723.186	2.723.186	2.723.186	2.723.186	2.723.186
1.1.1.3	Fuel saving (fuel oil etc.)	0		0	0	0	0	0	0
1.1.1.4	REC sales	0		0	0	0	0	0	0
1.2	**Cash Outflow**	**166.691.620**		**3.727.504**	**5.856.362**	**5.826.375**	**5.755.394**	**5.680.153**	**5.600.399**
1.2.1	***Cost of Sales***	***132.453.597***		***1.831.911***	***3.673.887***	***3.673.887***	***3.673.887***	***3.673.887***	***3.673.887***
1.2.1.1	Fuel supply	75.234.783		1.250.478	2.507.826	2.507.826	2.507.826	2.507.826	2.507.826
1.2.1.2	Power supply	11.520.000		191.474	384.000	384.000	384.000	384.000	384.000
1.2.1.3	Ash disposal	4.842.450		80.486	161.415	161.415	161.415	161.415	161.415
1.2.1.4	Water Treatment	3.600.000		59.836	120.000	120.000	120.000	120.000	120.000
1.2.1.5	Peak Load/ redundancy covering	4.200.430		69.815	140.014	140.014	140.014	140.014	140.014
1.2.1.6	Operating supplies	1.125.000		18.699	37.500	37.500	37.500	37.500	37.500
1.2.1.7	Major Overhaul	22.236.997		0	0	0	0	0	0
1.2.1.8	DHN O&M	9.693.938		161.123	323.131	323.131	323.131	323.131	323.131
1.2.2	***Selling & Administrative Expenses***	***17.165.868***		***285.314***	***572.196***	***572.196***	***572.196***	***572.196***	***572.196***
1.2.2.1	Salaries and wages	14.400.000		239.342	480.000	480.000	480.000	480.000	480.000
1.2.2.2	Service and maintenance	2.765.868		45.972	92.196	92.196	92.196	92.196	92.196
1.2.2.3	Miscellaneous	0		0	0	0	0	0	0
1.2.3	***Interest Paid***	***17.072.156***		***1.610.280***	***1.610.280***	***1.580.293***	***1.509.311***	***1.434.071***	***1.354.317***
1.2.3.1	SENIOR LOAN A	6.963.671		697.980	697.980	667.993	636.207	602.513	566.798
1.2.3.2	SENIOR LOAN B	10.108.485		912.300	912.300	912.300	873.105	831.558	787.519
1.2.4	***Bonds Paid***	***0***		***0***	***0***	***0***	***0***	***0***	***0***
1.2.3.3	Partner bond A	0		0	0	0	0	0	0
1.2.3.4	Partner bond B	0		0	0	0	0	0	0
1.2.3.5	Partner bond C	0		0	0	0	0	0	0
1.2.5	***Income Taxes***	***0***		***0***	***0***	***0***	***0***	***0***	***0***
	Increasing in Cash	**67.883.971**		**171.378**	**1.962.824**	**1.992.811**	**2.063.793**	**2.139.033**	**2.218.788**
	Cash in Beginning	**858.369.542**		**0**	**171.378**	**2.134.202**	**4.127.013**	**6.190.806**	**8.329.839**
	Cash in End of Year	**926.253.513**		**171.378**	**2.134.202**	**4.127.013**	**6.190.806**	**8.329.839**	**10.548.627**

Annex IV.A.8-D CASH FLOW STATEMENT

2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
1-Jan-17	**1-Jan-18**	**1-Jan-19**	**1-Jan-20**	**1-Jan-21**	**1-Jan-22**	**1-Jan-23**	**1-Jan-24**	**1-Jan-25**	**1-Jan-26**	**1-Jan-27**	**1-Jan-28**	**1-Jan-29**
31-Dec-17	**31-Dec-18**	**31-Dec-19**	**31-Dec-20**	**31-Dec-21**	**31-Dec-22**	**31-Dec-23**	**31-Dec-24**	**31-Dec-25**	**31-Dec-26**	**31-Dec-27**	**31-Dec-28**	**31-Dec-29**
0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%
7	8	9	10	11	12	13	14	15	16	17	18	19
2017	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**
2.303.327	**2.392.940**	**2.487.929**	**2.588.617**	**2.695.347**	**2.808.480**	**2.928.401**	**3.055.518**	**3.190.262**	**-18.836.108**	**3.484.488**	**3.567.787**	**3.572.785**
7.819.186	**7.819.186**	**7.819.186**	**7.819.186**	**7.819.186**	**7.819.186**	**7.819.186**	**7.819.186**	**7.819.186**	**7.819.186**	**7.819.186**	**7.819.186**	**7.819.186**
7.819.186	***7.819.186***	***7.819.186***	***7.819.186***	***7.819.186***	***7.819.186***	***7.819.186***	***7.819.186***	***7.819.186***	***7.819.186***	***7.819.186***	***7.819.186***	***7.819.186***
5.096.000	5.096.000	5.096.000	5.096.000	5.096.000	5.096.000	5.096.000	5.096.000	5.096.000	5.096.000	5.096.000	5.096.000	5.096.000
2.723.186	2.723.186	2.723.186	2.723.186	2.723.186	2.723.186	2.723.186	2.723.186	2.723.186	2.723.186	2.723.186	2.723.186	2.723.186
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
5.515.859	**5.426.247**	**5.331.258**	**5.230.569**	**5.123.840**	**5.010.706**	**4.890.785**	**4.763.668**	**4.628.925**	**26.655.295**	**4.334.698**	**4.251.399**	**4.246.401**
3.673.887	***3.673.887***	***3.673.887***	***3.673.887***	***3.673.887***	***3.673.887***	***3.673.887***	***3.673.887***	***3.673.887***	***25.910.883***	***3.673.887***	***3.673.887***	***3.673.887***
2.507.826	2.507.826	2.507.826	2.507.826	2.507.826	2.507.826	2.507.826	2.507.826	2.507.826	2.507.826	2.507.826	2.507.826	2.507.826
384.000	384.000	384.000	384.000	384.000	384.000	384.000	384.000	384.000	384.000	384.000	384.000	384.000
161.415	161.415	161.415	161.415	161.415	161.415	161.415	161.415	161.415	161.415	161.415	161.415	161.415
120.000	120.000	120.000	120.000	120.000	120.000	120.000	120.000	120.000	120.000	120.000	120.000	120.000
140.014	140.014	140.014	140.014	140.014	140.014	140.014	140.014	140.014	140.014	140.014	140.014	140.014
37.500	37.500	37.500	37.500	37.500	37.500	37.500	37.500	37.500	37.500	37.500	37.500	37.500
0	0	0	0	0	0	0	0	0	22.236.997	0	0	0
323.131	323.131	323.131	323.131	323.131	323.131	323.131	323.131	323.131	323.131	323.131	323.131	323.131
572.196	***572.196***	***572.196***	***572.196***	***572.196***	***572.196***	***572.196***	***572.196***	***572.196***	***572.196***	***572.196***	***572.196***	***572.196***
480.000	480.000	480.000	480.000	480.000	480.000	480.000	480.000	480.000	480.000	480.000	480.000	480.000
92.196	92.196	92.196	92.196	92.196	92.196	92.196	92.196	92.196	92.196	92.196	92.196	92.196
0	0	0	0	0	0	0	0	0	0	0	0	0
1.269.777	***1.180.164***	***1.085.175***	***984.487***	***877.758***	***764.624***	***644.703***	***517.586***	***382.842***	***172.216***	***88.616***	***5.317***	***319***
528.940	488.810	446.273	401.183	353.388	302.726	249.023	192.099	131.759	0	0	0	0
740.837	691.354	638.903	583.304	524.369	461.899	395.680	325.487	251.084	172.216	88.616	5.317	319
0	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***
2.303.327	**2.392.940**	**2.487.929**	**2.588.617**	**2.695.347**	**2.808.480**	**2.928.401**	**3.055.518**	**3.190.262**	**-18.836.108**	**3.484.488**	**3.567.787**	**3.572.785**
10.548.627	**12.851.954**	**15.244.894**	**17.732.822**	**20.321.439**	**23.016.786**	**25.825.266**	**28.753.667**	**31.809.185**	**34.999.447**	**16.163.339**	**19.647.827**	**23.215.614**
12.851.954	**15.244.894**	**17.732.822**	**20.321.439**	**23.016.786**	**25.825.266**	**28.753.667**	**31.809.185**	**34.999.447**	**16.163.339**	**19.647.827**	**23.215.614**	**26.788.399**

Annex IV.A.8-D CASH FLOW STATEMENT

2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
1-Jan-30	**1-Jan-31**	**1-Jan-32**	**1-Jan-33**	**1-Jan-34**	**1-Jan-35**	**1-Jan-36**	**1-Jan-37**	**1-Jan-38**	**1-Jan-39**	**1-Jan-40**	**1-Jan-41**
31-Dec-30	**31-Dec-31**	**31-Dec-32**	**31-Dec-33**	**31-Dec-34**	**31-Dec-35**	**31-Dec-36**	**31-Dec-37**	**31-Dec-38**	**31-Dec-39**	**31-Dec-40**	**31-Dec-41**
0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	50,1%
20	21	22	23	24	25	26	27	28	29	30	31
2030	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**
3.573.085	**3.573.103**	**3.573.104**	**3.573.104**	**3.573.104**	**3.573.104**	**3.573.104**	**3.573.104**	**3.573.104**	**3.573.104**	**3.573.104**	**1.791.447**
7.819.186	**7.819.186**	**7.819.186**	**7.819.186**	**7.819.186**	**7.819.186**	**7.819.186**	**7.819.186**	**7.819.186**	**7.819.186**	**7.819.186**	**3.920.304**
7.819.186	***7.819.186***	***7.819.186***	***7.819.186***	***7.819.186***	***7.819.186***	***7.819.186***	***7.819.186***	***7.819.186***	***7.819.186***	***7.819.186***	***3.920.304***
5.096.000	5.096.000	5.096.000	5.096.000	5.096.000	5.096.000	5.096.000	5.096.000	5.096.000	5.096.000	5.096.000	2.554.981
2.723.186	2.723.186	2.723.186	2.723.186	2.723.186	2.723.186	2.723.186	2.723.186	2.723.186	2.723.186	2.723.186	1.365.324
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
4.246.101	**4.246.083**	**4.246.082**	**4.246.082**	**4.246.082**	**4.246.082**	**4.246.082**	**4.246.082**	**4.246.082**	**4.246.082**	**4.246.082**	**2.128.858**
3.673.887	***3.673.887***	***3.673.887***	***3.673.887***	***3.673.887***	***3.673.887***	***3.673.887***	***3.673.887***	***3.673.887***	***3.673.887***	***3.673.887***	***1.841.976***
2.507.826	2.507.826	2.507.826	2.507.826	2.507.826	2.507.826	2.507.826	2.507.826	2.507.826	2.507.826	2.507.826	1.257.348
384.000	384.000	384.000	384.000	384.000	384.000	384.000	384.000	384.000	384.000	384.000	192.526
161.415	161.415	161.415	161.415	161.415	161.415	161.415	161.415	161.415	161.415	161.415	80.929
120.000	120.000	120.000	120.000	120.000	120.000	120.000	120.000	120.000	120.000	120.000	60.164
140.014	140.014	140.014	140.014	140.014	140.014	140.014	140.014	140.014	140.014	140.014	70.199
37.500	37.500	37.500	37.500	37.500	37.500	37.500	37.500	37.500	37.500	37.500	18.801
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323.131	323.131	323.131	323.131	323.131	323.131	323.131	323.131	323.131	323.131	323.131	162.008
572.196	***572.196***	***572.196***	***572.196***	***572.196***	***572.196***	***572.196***	***572.196***	***572.196***	***572.196***	***572.196***	***286.882***
480.000	480.000	480.000	480.000	480.000	480.000	480.000	480.000	480.000	480.000	480.000	240.658
92.196	92.196	92.196	92.196	92.196	92.196	92.196	92.196	92.196	92.196	92.196	46.224
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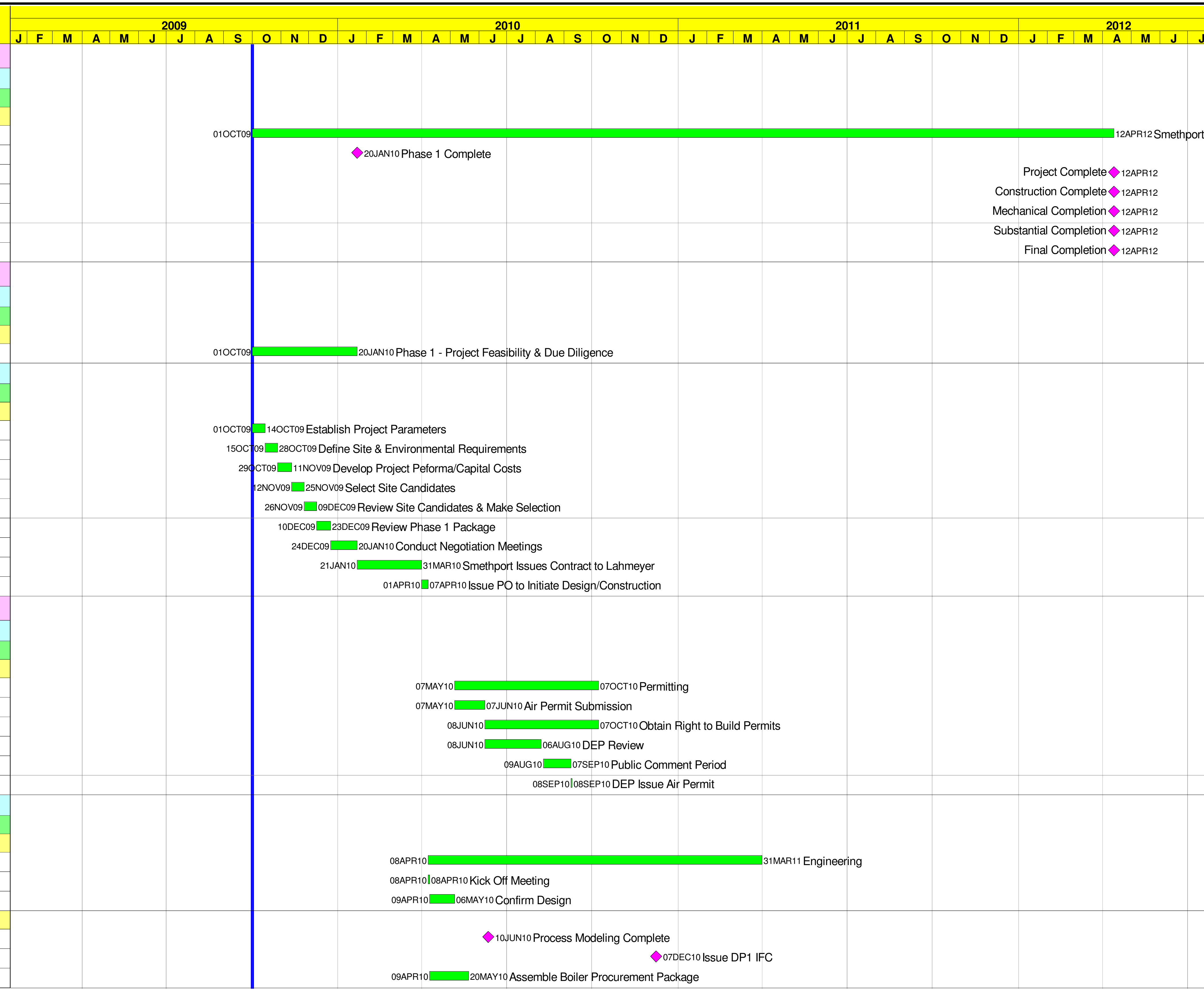
3.573.085	**3.573.103**	**3.573.104**	**3.573.104**	**3.573.104**	**3.573.104**	**3.573.104**	**3.573.104**	**3.573.104**	**3.573.104**	**3.573.104**	**1.791.447**
26.788.399	**30.361.484**	**33.934.587**	**37.507.691**	**41.080.795**	**44.653.899**	**48.227.003**	**51.800.108**	**55.373.212**	**58.946.316**	**62.519.420**	**66.092.524**
30.361.484	**33.934.587**	**37.507.691**	**41.080.795**	**44.653.899**	**48.227.003**	**51.800.108**	**55.373.212**	**58.946.316**	**62.519.420**	**66.092.524**	**67.883.971**

Annex V.C

Project Schedule

Activity ID	Activity Description	Orig Dur	Early Start	Early Finish
Project Summary				
AD9000	Smethport Combined Heat & Power Project	661*	01OCT09	12APR12
PM0006	Phase 1 Complete	0		20JAN10
AD9999	Project Complete	0		12APR12
PM0001	Construction Complete	0		12APR12
PM0002	Mechanical Completion	0		12APR12
PM0003	Substantial Completion	0		12APR12
PM0004	Final Completion	0		12APR12
Phase 1 - Project Feasibility & Due Diligence				
Administrative				
AD007	Phase 1 - Project Feasibility & Due Diligence	80*	01OCT09	20JAN10
Due Diligence/Feasibility				
AD017	Establish Project Parameters	10	01OCT09	14OCT09
AD019	Define Site & Environmental Requirements	10	15OCT09	28OCT09
AD021	Develop Project Peforma/Capital Costs	10	29OCT09	11NOV09
AD023	Select Site Candidates	10	12NOV09	25NOV09
AD025	Review Site Candidates & Make Selection	10	26NOV09	09DEC09
AD003	Review Phase 1 Package	10	10DEC09	23DEC09
AD005	Conduct Negotiation Meetings	20	24DEC09	20JAN10
AD015	Smethport Issues Contract to Lahmeyer	50	21JAN10	31MAR10
AD027	Issue PO to Initiate Design/Construction	5	01APR10	07APR10
Phase 2 - Implementation				
Permitting				
PM1000	Permitting	110*	07MAY10	07OCT10
PM1002	Air Permit Submission	22	07MAY10	07JUN10
PM1010	Obtain Right to Build Permits	88	08JUN10	07OCT10
PM1004	DEP Review	44	08JUN10	06AUG10
PM1006	Public Comment Period	22	09AUG10	07SEP10
PM1008	DEP Issue Air Permit	1	08SEP10	08SEP10
Engineering				
Administrative				
EN1013	Engineering	256*	08APR10	31MAR11
EN1001	Kick Off Meeting	1	08APR10	08APR10
EN1011	Confirm Design	20	09APR10	06MAY10
Design Package 1				
EN1215	Process Modeling Complete	0		10JUN10
EN1295	Issue DP1 IFC	0		07DEC10
EN1105	Assemble Boiler Procurement Package	30	09APR10	20MAY10



Start Date	01OCT09
Finish Date	12APR12
Data Date	01OCT09
Run Date	12NOV09 13:08

Early Bar
Progress Bar
Critical Activity

SMPT

Borough of Smethport

Combined Heat & Power (CHP) Project

O'Brien & Gere

Preliminary

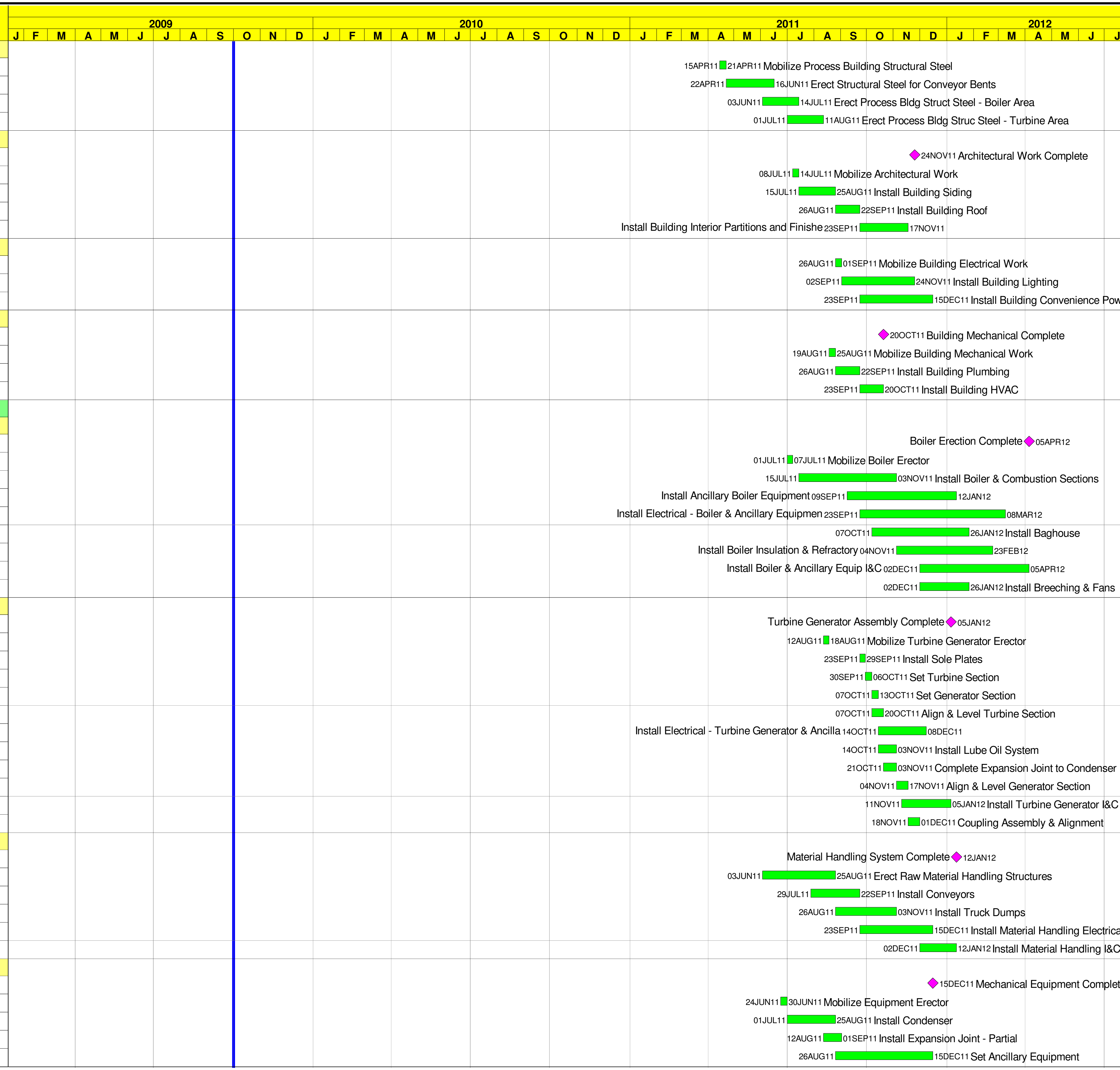
Date	Revision	Checked	Approved

O'BRIEN & GERE

Activity ID	Activity Description	Orig Dur	Early Start	Early Finish
EN1115	Assemble Turbine GeneratorProcurement Package	30	09APR10	20MAY10
EN1125	Assemble Material Handling Procurement Package	30	09APR10	20MAY10
EN1005	Develop Process Flow Diagrams	15	21MAY10	10JUN10
EN1085	Perform Heat & Mass Balances	15	21MAY10	10JUN10
EN1095	Perform Utility Balance	15	21MAY10	10JUN10
EN1205	Develop & Finalize P&ID's	75	11JUN10	23SEP10
EN1305	Assemble Condenser Procurement Package	10	11JUN10	24JUN10
EN1135	Develop Site & Building General Arrangement	60	25JUN10	16SEP10
EN1155	Develop Master Electrical One-line	20	23JUL10	19AUG10
EN1165	Develop 4160 & 480 V One-line	20	30JUL10	26AUG10
EN1145	Develop Control System Descriptions	20	06AUG10	02SEP10
EN1175	Develop Relay & Metering One-line	20	27AUG10	23SEP10
EN1185	Develop Electrical System Description	20	24SEP10	21OCT10
EN1195	Assemble &Submit for Review Documents for DP1	3	22OCT10	26OCT10
EN1275	Review DP1	10	27OCT10	09NOV10
EN1285	Incorporate Comments into Design	20	10NOV10	07DEC10
Design Package 2				
EN1365	Issue DP2 IFC	0		31MAR11
EN1059	Develop Site/Civil, Site Electrical, UG Utility	60	23JUL10	14OCT10
EN1069	Develop Structural/Architectural Package	80	20AUG10	09DEC10
EN1039	Develop Ancillary Equipment Procurement Packages	80	20AUG10	09DEC10
EN1049	Develop Building Mechanical Package - HVAC & Plu	40	17SEP10	11NOV10
EN1019	Develop Demolition & Deep Foundation Package	60	22OCT10	13JAN11
EN1029	Develop Process Mechanical/Piping Package	80	22OCT10	10FEB11
EN1315	Assemble &Submit for Review Documents for DP1	5	11FEB11	17FEB11
EN1335	Review DP2	10	18FEB11	03MAR11
EN1355	Incorporate Comments into Design	20	04MAR11	31MAR11
Design Package 3				
EN1385	Issue DP3 IFC	0		31MAR11
EN1025	Develop Building Electrical Package - Light & Po	60	27AUG10	18NOV10
EN1009	Develop Process Electrical Package	80	24SEP10	13JAN11
EN1035	Develop Instrumentation & Control Package - DCS	60	19NOV10	10FEB11
EN1325	Assemble &Submit for Review Documents for DP3	5	11FEB11	17FEB11
EN1345	Review DP3	10	18FEB11	03MAR11
EN1375	Incorporate Comments into Design	20	04MAR11	31MAR11
Close Out Documents				
EN1045	Develop Post-Construction Package	60	01APR11	23JUN11
Procurement				
Process Equipment				
Boiler System				
PR1001	Bid & Award Boiler System	30	21MAY10	01JUL10
PR1017	Submit & Approve Preliminary Boiler System Info	40	02JUL10	26AUG10
PR1035	Fab & Deliver Boiler System - Initial	140	02JUL10	13JAN11
PR1137	Submit & Approve Detailed Boiler System Info	40	27AUG10	21OCT10
PR1055	Complete Boiler Delivery	50	14JAN11	24MAR11
Turbine Generator System				
PR1003	Bid & Award Turbine Generator	30	21MAY10	01JUL10
PR1019	Submit & Approve PreliminaryTurbine Generator Sy	30	02JUL10	12AUG10
PR1139	Submit & Approve DetailedTurbine Generator Syste	40	13AUG10	07OCT10
PR1057	Fab & Deliver Turbine Generator System	168	13AUG10	05APR11
Material Handling System				
PR1005	Bid & Award Material Handling Procurement Packag	30	21MAY10	01JUL10
PR1021	Submit & Approve Preliminary Material Handling S	40	02JUL10	26AUG10
PR1041	Submit & Approve Detailed Material Handling Syst	40	27AUG10	21OCT10
PR1051	Fab & Delivery Material Handling System - Initia	60	22OCT10	13JAN11
PR1039	Fab & Deliver Material Handling System - Final	100	14JAN11	02JUN11
Condenser				
PR1033	Bid & Award Condenser	20	25JUN10	22JUL10

Activity ID	Activity Description	Orig Dur	Early Start	Early Finish
PR1043	Submit & Approve Condenser - Preliminary	40	23JUL10	16SEP10
PR1053	Submit & Approve Condenser - Detailed	40	17SEP10	11NOV10
PR1063	Fab & Deliver Condenser	120	12NOV10	28APR11
Process Mechanical				
PR1009	Bid & Award Process Mechanical	20	11FEB11	10MAR11
Process Piping				
PR1095	Bid & Award Process Piping	30	11FEB11	24MAR11
Process Electrical				
PR1007	Bid & Award Process Electrical	30	14JAN11	24FEB11
Instrumentation & Control				
PR1023	Bid & Award Distributed Control System (DCS)	40	11FEB11	07APR11
PR1029	Submit & Approve Preliminary DCS Components	66	08APR11	08JUL11
PR1037	Fab & Deliver DCS Components	120	20MAY11	03NOV11
PR1129	Submit & Approve Detailed DCS Components	80	11JUL11	28OCT11
Ancillary Equipment				
PR1167	Bid & Award Ancillary Equipment	60	10DEC10	03MAR11
PR1157	Submit & Approve Ancillary Equipment	80	04MAR11	23JUN11
PR1147	Fabricate & Deliver Ancillary Equipment	120	29APR11	13OCT11
Infrastructure				
Site				
PR1011	Bid & Award Site/Civil Package	30	03SEP10	14OCT10
Concrete				
PR1013	Bid & Award Concrete Foundation & Slabs	30	12NOV10	23DEC10
Structural				
PR1047	Bid & Award Structural Steel	30	12NOV10	23DEC10
PR1067	Bid & Award Deep Foundations	30	17DEC10	27JAN11
PR1031	Submit & Approve Structural Steel	30	24DEC10	03FEB11
PR1045	Fab & Deliver Structural Steel	80	04FEB11	26MAY11
Architectural				
PR1015	Bid & Award Architectural	30	15OCT10	25NOV10
Building Electrical				
PR1059	Bid & Award Bldg Electrical	30	19NOV10	30DEC10
Building Mechanical				
PR1049	Bid & Award Bldg Mechanical	30	12NOV10	23DEC10
Construction				
Administrative				
Administrative				
CN9999	Construction Complete	0		12APR12
CN0000	Construction Start	0	15OCT10	
Infrastructure				
Site				
CN1210	Site Work Complete	0		25APR11
CN1000	Mobilize Site/Civil Work	5	15OCT10	21OCT10
CN1180	Clear Site	20	22OCT10	18NOV10
CN1130	Construct New Plant Access Road	30	22OCT10	02DEC10
CN1142	Construct District Heating Connection	132	22OCT10	25APR11
CN1140	Install Site Utilities	40	19NOV10	13JAN11
CN1170	Rough Grade Process Building Area	10	19NOV10	02DEC10
CN1150	Rough Grade Material Handling Area	10	14JAN11	27JAN11
CN1500	Install Piling for ProcessBldg, Boiler & Turbine	30	28JAN11	10MAR11
CN1510	Install Piling for Material Handling	20	28JAN11	24FEB11
Concrete				
CN1200	Concrete Complete	0		30JUN11
CN1010	Mobilize for Concrete Foundation & Slab Work	5	18FEB11	24FEB11
CN1190	Install Material Handling Foundations & Slabs	40	25FEB11	21APR11
CN1012	Install Process Bldg Foundations and Slabs	80	11MAR11	30JUN11
CN1270	Install Boiler & Turbine Foundations & Slabs	60	08APR11	30JUN11

Activity ID	Activity Description	Orig Dur	Early Start	Early Finish
Structural				
CN1020	Mobilize Process Building Structural Steel	5	15APR11	21APR11
CN1280	Erect Structural Steel for Conveyor Bents	40	22APR11	16JUN11
CN1300	Erect Process Bldg Struct Steel - Boiler Area	30	03JUN11	14JUL11
CN1290	Erect Process Bldg Struc Steel - Turbine Area	30	01JUL11	11AUG11
Architectural				
CN1520	Architectural Work Complete	0		24NOV11
CN1060	Mobilize Architectural Work	5	08JUL11	14JUL11
CN1320	Install Building Siding	30	15JUL11	25AUG11
CN1330	Install Building Roof	20	26AUG11	22SEP11
CN1310	Install Building Interior Partitions and Finishe	40	23SEP11	17NOV11
Building Electrical				
CN1110	Mobilize Building Electrical Work	5	26AUG11	01SEP11
CN1340	Install Building Lighting	60	02SEP11	24NOV11
CN1350	Install Building Convenience Power	60	23SEP11	15DEC11
Building Mechanical				
CN1530	Building Mechanical Complete	0		20OCT11
CN1100	Mobilize Building Mechanical Work	5	19AUG11	25AUG11
CN1370	Install Building Plumbing	20	26AUG11	22SEP11
CN1360	Install Building HVAC	20	23SEP11	20OCT11
Process Systems				
Boiler System				
CN1380	Boiler Erection Complete	0		05APR12
CN1030	Mobilize Boiler Erector	5	01JUL11	07JUL11
CN1620	Install Boiler & Combustion Sections	80	15JUL11	03NOV11
CN1590	Install Ancillary Boiler Equipment	90	09SEP11	12JAN12
CN1560	Install Electrical - Boiler & Ancillary Equipmen	120	23SEP11	08MAR12
CN1610	Install Baghouse	80	07OCT11	26JAN12
CN1580	Install Boiler Insulation & Refractory	80	04NOV11	23FEB12
CN1230	Install Boiler & Ancillary Equip I&C	90	02DEC11	05APR12
CN1600	Install Breeching & Fans	40	02DEC11	26JAN12
Turbine Generator System				
CN1400	Turbine Generator Assembly Complete	0		05JAN12
CN1040	Mobilize Turbine Generator Erector	5	12AUG11	18AUG11
CN1660	Install Sole Plates	5	23SEP11	29SEP11
CN1640	Set Turbine Section	5	30SEP11	06OCT11
CN1630	Set Generator Section	5	07OCT11	13OCT11
CN1650	Align & Level Turbine Section	10	07OCT11	20OCT11
CN1550	Install Electrical - Turbine Generator & Ancilla	40	14OCT11	08DEC11
CN1720	Install Lube Oil System	15	14OCT11	03NOV11
CN1710	Complete Expansion Joint to Condenser	10	21OCT11	03NOV11
CN1700	Align & Level Generator Section	10	04NOV11	17NOV11
CN1220	Install Turbine Generator I&C	40	11NOV11	05JAN12
CN1410	Coupling Assembly & Alignment	10	18NOV11	01DEC11
Material Handling System				
CN1540	Material Handling System Complete	0		12JAN12
CN1050	Erect Raw Material Handling Structures	60	03JUN11	25AUG11
CN1420	Install Conveyors	40	29JUL11	22SEP11
CN1430	Install Truck Dumps	50	26AUG11	03NOV11
CN1450	Install Material Handling Electrical	60	23SEP11	15DEC11
CN1240	Install Material Handling I&C	30	02DEC11	12JAN12
Process Mechanical				
CN1690	Mechanical Equipment Complete	0		15DEC11
CN1080	Mobilize Equipment Erector	5	24JUN11	30JUN11
CN1460	Install Condenser	40	01JUL11	25AUG11
CN1730	Install Expansion Joint - Partial	15	12AUG11	01SEP11
CN1470	Set Ancillary Equipment	80	26AUG11	15DEC11



Activity ID	Activity Description	Orig Dur	Early Start	Early Finish
Process Piping				
CN1680	Process Piping Complete	0		29MAR12
CN1070	Mobilize Process Piping	5	26AUG11	01SEP11
CN1480	Install Lo Press & Temp Systems	120	02SEP11	16FEB12
CN1490	Install Hi Press Hi Temp Piping Systems	120	16SEP11	01MAR12
CN1670	Pipe Insulation	80	09DEC11	29MAR12
Process Electrical				
CN1570	Process Electrical Complete	0		12APR12
CN1090	Mobilize Process Electrical	5	15JUL11	21JUL11
Instrumentation & Control				
CN1250	Instrumentation Complete	0		05APR12
CN1260	Mobilize I&C	5	12AUG11	18AUG11
CN1120	Install DCS System & Components	120	02SEP11	16FEB12
Startup & Commissioning				
Startup & Commissioning				
Administrative				
SU110	Substantial Completion	0		12APR12
SU90	Mechanical Completion	0		12APR12