LIFE SCIENCES AND NATURAL RESOURCES

WATER TECHNOLOGY

WAGENINGEN UNIVERSITY AND RESEARCH

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REPORT ON THE MASTER'S PROGRAMME WATER TECHNOLOGY OF WAGENINGEN UNIVERSITY AND RESEARCH

This report takes the NVAO's Assessment Framework for Limited Programme Assessments as a starting point (September 2016).

ADMINISTRATIVE DATA REGARDING THE PROGRAMME

Master's programme Water Technology

Name of the programme:	Water Technology
CROHO number:	65005
Level of the programme:	master's
Orientation of the programme:	academic
Number of credits:	120 EC
Specializations or tracks:	-
Location(s):	Leeuwarden
Mode(s) of study:	full time
Joint programme:	
partner institutions involved:	Wageningen University and Research, Rijksuniversiteit Groningen, Universiteit Twente
type of degree awarded:	Master of Science (joint degree)
Language of instruction:	English
Expiration of accreditation:	01/01/2020

The visit of the assessment panel Water Technology to Wageningen University and Research took place on 20 and 21 September 2018 at Wetsus (Leeuwarden).

ADMINISTRATIVE DATA REGARDING THE INSTITUTION

Name of the institution:	Wageningen University and Research
Status of the institution:	publicly funded institution
Result institutional quality assurance assessment:	positive

COMPOSITION OF THE ASSESSMENT PANEL

The NVAO has approved the composition of the panel on 5 March 2018. The panel that assessed the master's programme Water Technology consisted of:

- Prof. dr. S. (Stanley) Brul [chair], professor Molecular Biology and Microbial Food Safety at the University of Amsterdam and chair of the Dutch institute for Biology (NIBI);
- Dr. A. A. J. (Annik) Van Keer, educational advisor at the Faculty of Science at Utrecht University;
- Prof. dr. ir. M. (Merle) de Kreuk, professor Environmental Technology at the faculty of Civil Engineering and Geosciences at Delft University of Technology;
- Em. prof. dr. ir W. (Willy) Verstraete, emeritus professor Environmental Biotechnology at Ghent University (Belgium);
- M. (Marit) de Kort [student member], master's student Cancer, Stem Cells and Developmental Biology at Utrecht University.

The panel was supported by dr. A. (Alexandra) Paffen, who acted as secretary.

WORKING METHOD OF THE ASSESSMENT PANEL

Preparation
In preparation for the site visit, the panel studied several documents: the NVAO assessment framework (2016), the institutional audit of WUR and the previous Water Technology (WT) programme assessment (from 2012). The accreditation system has entered its third phase (concurrently with a second round of institutional audits). Wageningen University and Research has recently successfully passed its second institutional audit. The new NVAO assessment framework is "geared to a quality assurance system that is based on trust in the existing, high quality of Dutch higher education".

In 2012 the then new WT programme was assessed with an overall satisfactory score. The recommendations that the previous panel made were picked up by the programme.

With the new philosophy of the framework and the last assessment of this specific programme in mind, the panel (of peers) does not want to elaborate too long on the different criteria of the four standards of the limited framework in this report. The overall evaluation of the programme meets the standard, as it did in 2012. Therefore, the panel wants to concentrate on how the programme has developed since 2012 and where it can become even better than it already is.

QANU received the self-assessment report of the master's programme Water Technology on 2 August 2018 and made it available to the panel. The panel members read it and prepared questions, comments and remarks prior to the site visit. The secretary collected these questions in a document and arranged them according to panel conversation and subject.

In addition, the panel members read recent theses from the master programme. In consultation with the chair, fifteen theses were selected from the previous academic years, covering the full range of marks given. The panel members also received the grades and the assessment forms filled out by the examiners and supervisors. An overview of documents reviewed by the panel is included in Appendix 5.

The project manager drafted a programme for the site visit. This was discussed with the chair of the panel and the policy officer. As requested by QANU, the programme management carefully selected discussion partners. A schedule of the programme for the site visit is included in Appendix 4.

Site visit
The site visit took place on 20 and 21 September 2018 at Wetsus (Leeuwarden). In a preparatory meeting on the day of the site visit, the panel members discussed their findings based on the self-assessment report and on the theses and formulated the questions and issues to be raised in the interviews with representatives of the programme and other stakeholders.

During the site visit, the panel studied a selection of documents provided by the programme management. They included course descriptions, course materials, written exams, assignments and other assessments.

The panel interviewed the programme management, students, alumni, staff members, members of the Programme Committee and members of the Examining Board.

After the final meeting with the management, the panel members extensively discussed their assessment of the programme and prepared a preliminary presentation of the findings. The site visit was concluded with a presentation of these preliminary findings by the chair.

Report
After the visit, the secretary produced a draft version of the report. She submitted the report to the panel members for comments. She processed corrections, remarks and suggestions for improvement provided by the panel members to produce the revised draft report. This was then sent to the programme management to check for factual errors. The comments and suggestions provided by the programme management were discussed with the chair of the assessment panel and, where necessary, with the other panel members. After incorporating the panel's comments, the secretary compiled the final version of the report.

Definition of assessment standards
In accordance with the NVAO's Assessment framework for limited programme assessments, the panel used the following definitions for the assessment of both the standards and the programme as a whole.

Generic quality
The quality that, in an international perspective, may reasonably be expected from a higher education Associate Degree, Bachelor's or Master's programme.

Unsatisfactory
The programme does not meet the generic quality standard and shows shortcomings with respect to multiple aspects of the standard.

Satisfactory
The programme meets the generic quality standard across its entire spectrum.

Good
The programme systematically surpasses the generic quality standard.

Excellent
The programme systematically well surpasses the generic quality standard and is regarded as an international example.

SUMMARY JUDGEMENT

Standard 1
The panel has established that the master's programme Water Technology is a multidisciplinary programme with a clear profile embedded in a top research environment. It has very good links with the professional field both inside and outside academia. The ILOs are aligned to the Dublin descriptors for academic master's programmes, but could be made more explicit and better linked to the profile. The panel thinks that although the current profile and ILOs are clear, they do too little justice to the breadth of the programme. The profile and ILOs should reflect both the academic, research pillar and the more applied, technological side that characterizes this programme. Finally, the visibility and branding of the Wetsus Academy (which includes this master's programme) could potentially be made stronger both nationally and internationally by cooperating in a broader international context.

Standard 2
Although there is room for improvement, the panel thinks Wetsus offers a great and inspiring learning environment with excellent facilities for its master students. It was pleased with the balanced structure and design of the first-year curriculum. It was particularly pleased with the last two courses of the first year: the *Computational Methods* course and the cooperative project (Business Case), which combines all of the previously learnt skills to design a solution for a relevant real-world issue. It learned that all the ILOs are reflected in the curriculum, but how the learning goals of the different courses relate to the ILOs should be made clear.

The second year consists of a thesis/research project of 40 EC and an internship of 15 EC. The panel was very impressed by the attention paid to the final research project/thesis, in terms of both quantity (40 EC) and quality (supervision). It was also impressed by the professional connections of the programme and the large number of internship possibilities available, although it considers an internship of 15 EC too short.

The three universities (WUR, RUG and TU) are jointly responsible for the curriculum, with a course load division of 44% (WUR), 36% (RUG) and 20% (TU), respectively. The panel established that the teaching staff are experts in scientific and professional respects. They are also enthusiastic and committed, and students appreciate their accessibility. The panel thinks it is key for the staff to interact on a regular basis, especially with a joint degree with most staff working simultaneously at a "home" university and in the joint programme.

Finally, the good study success rates indicate, that the programme succeeds in getting all students (from different educational and cultural backgrounds) at the same academic level.

Standard 3
The panel finds that WUR has a good general assessment policy to which the WT assessment policy in general is aligned. The programme applies different assessment methods that are matched to the different learning outcomes. All learning outcomes are tested. There is a distinction between the assessment methods used and the complexity of the learning outcomes. The course guide contains an assessment strategy for each course. The panel judges the assessments to be clear and transparent, although it would advise the staff and programme management to design a matrix that aligns the ILOs to the courses' learning objectives..

The panel believes that the EB knows its legal duties and responsibilities, is pro-active and in control. Some assessment procedures could benefit from more calibration and could be professionalized and simplified by, for instance, digitalizing the assessment forms.

According to the panel, the overall thesis and internship assessments and procedures are thorough, although it has a few comments concerning the assessment forms. It would advise the programme to make its own assessment forms and rubrics and to make a difference between the forms of the thesis and internship.

Standard 4
To review the achieved ILOs, the panel studied several documents and 15 theses. Overall, it agreed with the grading and considered the theses to be of a proper scientific level. All of the studied theses are final products of an academic master's degree programme and showed that the students had achieved the ILOs.

The panel spoke at length with staff, students and alumni about the connection to the professional field. It was very impressed by the excellent connections of the programme to the work field. During the programme, students are thoroughly prepared for a position in the professional field. Alumni of the programme are very satisfied and feel very well prepared for jobs, especially inside but also outside academia.

The panel assesses the standards from the *Assessment framework for limited programme assessments* in the following way:

Master's programme Water Technology

Standard 1: Intended learning outcomes	satisfactory
Standard 2: Teaching-learning environment	good
Standard 3: Student assessment	satisfactory
Standard 4: Achieved learning outcomes	good
General conclusion	good

The chair, prof. dr. S. Brul, and the secretary of the panel, dr. A Paffen, hereby declare that all panel members have studied this report and that they agree with the judgements laid down in it. They confirm that the assessment has been conducted in accordance with the demands relating to independence.

Date: 20 February 2019

DESCRIPTION OF THE STANDARDS FROM THE ASSESSMENT FRAMEWORK FOR LIMITED FRAMEWORK ASSESSMENTS

Standard 1: Intended learning outcomes
The intended learning outcomes tie in with the level and orientation of the programme; they are geared to the expectations of the professional field, the discipline, and international requirements.

Findings

Profile and objective
The master's programme Water Technology (WT) is a joint degree resulting from a collaboration between Wageningen University and Research (WUR), University of Twente (UT) and University of Groningen (RUG). The programme, which was originally developed as a track in 2008, was a bottom-up initiative of the programme directors of the master's programme Biotechnology (WUR) and the master's programme Chemical Engineering (RUG and UT). The programme is part of the Wetsus Academy that is embedded in the Wetsus Research Institute at the Water Campus of Leeuwarden. Wetsus is a European Centre of Excellence for Sustainable Water Technology. Leeuwarden has the ambition to become the Capital of Water Technology. The profile of the programme is strongly connected to the research areas of Wetsus: 1. Sustainable water supply; 2. Waste water treatment and reuse; 3. New water sources; 4. Reuse and production of components and energy from water; 5. Detection of pathogens and micro/nano-pollutants. The panel studied the partnership agreement of this joint degree and found that the collaboration is visible both in the governance structure and in the educational cooperation.

The master's programme WT is a multidisciplinary programme that combines a technological and scientific approach to finding sustainable solutions for global and local threats and challenges to the environment. It explicitly looks at sustainable water treatment technologies in a broader perspective than only the purification of water. It also focuses on the recovery of raw materials from processing waste water and the production of sustainable energy. According to the panel, it is a good addition to other Dutch and international programmes related to water technology (for instance, the programme at the Centre of Environmental Sanitation of Ghent University, or the water technology-related specialisations within the MSc tracks Environmental Engineering, Life Science and Technology and Water Management at TU Delft), in the sense that the main focus is on science and technology to understand the aspects of quality, use, purification and reuse of water and their coupling to current PhD and company projects within the WETSUS society.

The master's programme WT derives its scientific knowledge mainly from two domains: life sciences and physical sciences. It uses the scientific insights from a range of disciplines such as membrane science, microbiology, process engineering, electrochemistry and water physics, and combines them with the technological application of biological systems and the engineering principles to carry out (bio)chemical processes. Students learn to develop, propagate and apply innovations and sustainable optimizations, and create new insights within the broader framework of the growing scarcity of raw materials (mainly water), energy and the associated pollution. The programme aims to educate students to become design-oriented researchers and prepares them for a position in which research plays a major role, as a tool for problem-solving, design and innovation.

The panel believes the programme has a clear profile: an engineering programme based on innovation, design and application, and is therefore a good addition to other national and international water technology-based programmes. It was very impressed by the facilities and the embedding of the programme in a top Research Institute and community (Wetsus). But, as was already pointed out by the last assessment panel, the visibility and branding of the Wetsus Academy (which includes this master's programme) in the Netherlands and abroad could potentially be made stronger by cooperating in a broader international context. The panel thinks that this is key to making the programme future-proof and will help resolve the continuing issue of low intake.

Intended learning outcomes, level and orientation
The above-mentioned objective of the programme has been translated into 13 intended learning outcomes (ILOs) (see appendix 2). They are linked to the Dublin descriptors for master's programmes. The ILOs are clustered: the domain of the field of study involved (ILOs 1-7), the academic method of thinking and doing (ILOs 8-11) and the context of practising science (ILOs 12-13). The master's level is emphasized in the ILOs by paying specific and advanced attention to analysis, judgement, design and reflection. The panel found the ILOs to be well structured and definitely of a master's level. It does believe that the specific characteristics of the Water Technology profile could be made more explicit, especially in the first three ILOs. It would advise the management team to critically review the ILOs, so that they do justice to the profile.

The orientation of the programme is clearly academic. It is strongly embedded within the Research Institute of Wetsus, and during most of the second year, students perform research under daily supervision by PhD students from Wetsus. Wetsus has a large international network of industrial partners and research groups that participate in the research programme. The research projects are both defined by and discussed with companies and knowledge institutes. The professional field directly fuels the research. The panel believes that it is the combination of the academic, scientific approach with the more applied and professional approach (e.g. the development of innovative technologies) that defines and characterizes this programme. This could be accentuated more in both the profile and the ILOs.

Link with the professional field
The WT master's programme aims to educate not only specialists but also professionals, who can build a bridge between science and engineering applications. With its embedding in Wetsus, there is foremost a clear and very strong link with the professional field of science and research. Students are taught in an environment close to their future work field by teachers active in research, and they get to work on socially relevant and real-world problems. The panel learned that the link with the professional field outside of academia is also very good. The programme has connections with more than 100 companies, which also provide internships for the master students of the WT programme. The panel was very impressed by these connections with the professional field. Again it thinks that the programme can frame itself as much more than "just" academic and scientific.

Considerations
The panel has established that the master's programme Water Technology is a multidisciplinary programme with a clear profile embedded in a top research environment. It has very good links with the professional field both inside and outside academia. The ILOs are aligned to the Dublin descriptors for academic master's programmes, but could be made more explicit and better linked to the profile. The panel thinks that although the current profile and ILOs are clear, they do too little justice to the breadth of the programme. The profile and ILOs should reflect both the academic, research pillar and the more applied, technological side that characterizes this programme. Finally, the visibility and branding of the Wetsus Academy (which includes this master's programme) could potentially be made stronger both nationally and internationally by cooperating in a broader international context.

Conclusion
Master's programme Water Technology: the panel assesses Standard 1 as 'satisfactory'.

Standard 2: Teaching-learning environment
The curriculum, the teaching-learning environment and the quality of the teaching staff enable the incoming students to achieve the intended learning outcomes.

Findings

Curriculum, content and design
The curriculum consists of 120 EC. The first year has mainly compulsory courses of 5 EC and a compulsory *Business Case Design Project* of 10 EC. The second year has one optional course (5 EC), an internship (15 EC) and a thesis of 40 EC. The programme starts with the course *Water Technologies in Global Context.* It continues with four courses from different perspectives (disciplines), in which students focus on natural and physical theories and research applications. One of the four courses is compulsory (*Colloid Chemistry*), and students have to select two of the other three courses. Depending on their educational background, students may have to attend all four courses offered.

The learning path continues with four courses in Water Engineering, which focus on the integration of water treatment and recovery concepts and design issues (when performing reactors). Students apply acquired knowledge and understanding to the design of new technologies. They learn to produce the best solution for a real-world problem. The first-year learning path is completed with two courses: *Computational Methods in Water Technology* and the *Business Case Design Project*. In these courses students learn how to integrate the results from the engineering part in the context of business and society. An overview of the curriculum can be found in appendix 3.

The panel was pleased with the balanced structure and design of the first year building up to the *Business Case Design Project*. The courses are relevant and give in-depth theoretical knowledge about the different aspects of Water Technology. The panel was particularly pleased with the last two courses of the first year: it found the *Computational Methods* course very good and was impressed with the cooperative project (Business Case), which combines all of the previously learnt skills to design a solution for a relevant real-world issue.

The panel found that the ILOs are reflected in the curriculum. It does think there is room for improvement in clarifying how the learning goals of the different courses relate to the ILOs. For instance, it specifically asked about ILO 13 and learned that attention is paid to ethical issues and normative aspects in different courses. It would advise the management and staff to make a matrix linking the courses to the ILOs. In the study guide the learning goals of the courses should also be linked to the ILOs.

Thesis and internship
The second year consists of a thesis/research project of 40 EC, conducted under the supervision of a professor of WUR, UT or RUG in ongoing academic research in the field of sustainable water technology at the Wetsus Lab. Each student is individually mentored by a PhD student on a daily basis and supervised by his/her supervisor. As well as acquiring advanced knowledge and skills in the domain of water technology and in the field of their chosen topic, students acquire professional and academic competences to execute a research project independently. The thesis concludes with a written report and an oral presentation (with a focus on scientific reasoning and experimental methods and results) for an academic audience.

The panel was very impressed by the attention that is paid to the final research project/thesis, in terms of both quantity (40 EC) and quality (supervision). It learned during the site visit that the PhD student supervisors are thoroughly trained during a Wetsus Personal Development Program, which includes a 2-day course on student supervision. The PhD students told the panel that they felt very well prepared by the Personal Development Program, and the master students really appreciated the daily supervision by the PhD students. The panel wondered if some parts of the training program for PhD students can be made available for master students to prepare them for their future careers.

Alongside the research project, there is an internship of 15 EC in the second year. Students contribute to ongoing research or projects within process technology or engineering units at small and medium-sized enterprises (SME), consultancy agencies, research institutes or public utilities. Because the programme has connections with more than 100 companies that provide internships, students can very easily find an internship. They are supervised by an in-company supervisor, who evaluates their performance. The internship concludes with a written report, a self-reflection on the internship, and an oral presentation and examination that are also assessed by an examiner from one of the involved universities.

The panel had some concerns with regard to the internship that were also shared by the master students during the site visit. Although it was impressed by the professional connections of the programme and the large number of internship possibilities available, it feels that an internship of 15 EC is too short and may be focused too much on carrying out a research project in a professional environment. As was already mentioned under Standard 1, in the panel's view the programme has a strong academic/scientific pillar, but also a more applied, professional one. It would advise the programme to consider lengthening the internship. It thinks this will be beneficial for both the students and internship providers.

Didactic approach
The didactic approach of the programme is "learning in a research community". It is a small-scale programme (intake of 15-20 students) that enables tailor-made, interactive and intensive education. It uses a variety of teaching methods, e.g. lectures, tutorials, practicals, group work, excursions. There is also room for more innovative, experimental methods such as peer review, blended learning, flipped classroom. The panel learned during the site visit that some lecturers also make room for question hours, and it approves this initiative. Because of the small scale, it would advise the programme to think of including other aspects of summative assessments, such as oral examinations, which enable lecturers to profoundly assess knowledge and understanding.

From the documentation it studied and the interviews held during the site visit, the panel concluded that the first-year students feel less connected to Wetsus because they follow their courses outside of the Wetsus building in the Van Hall Larenstein building (University of Applied Sciences). The programme is pro-actively responding to this feedback from the students and is now making it possible for the first-year students to also be educated at the Wetsus Academy. The panel applauds this development and thinks that it will stimulate the approach of "learning in a research community" even more.

Staff and supervision
The three universities (WUR, RUG and TU) are jointly responsible for the curriculum, with a course load division of 44% (WUR), 36% (RUG) and 20% (TU), respectively. All staff members have a PhD and are active in research. Three staff members are employed by Wetsus, and about 60% (the Wetsus staff members not included) are involved in the research programme of Wetsus. Staff members either have a University Teaching Qualification (UTQ, the majority) or are in the process of getting one, or have demonstrated sufficient experience in education.

The panel established that the teaching staff are experts in scientific and professional respects. They are also enthusiastic and committed. Both management and students appreciate their expertise. Students find the teachers very accessible and also feel that their feedback is taken very seriously. The above-mentioned facilities that are being created for the first-year students in the Wetsus building are the result of student feedback, as is the fact that the internship is now taking place at the end of the second year (instead of the first year). There is a formal Programme Committee with three staff members (with one representative from each university) and three student members. The staff also includes a study advisor/programme director in case students need any kind of help personally or concerning their studies. The panel did notice that because of the small scale of the programme, some staff members have several roles. It feels the programme could be vulnerable in

this respect and would advise dividing some of the responsibilities, if possible. The panel also noticed during the site visit that, until recently, it was difficult to get all of the staff together (from the three universities involved), for instance, to discuss the curriculum. There was mainly interaction between staff members who worked together on courses and the three staff members employed by Wetsus. The management has anticipated this issue by seeing to it that all lecturers involved in the programme are at Wetsus once a week on the same day (Thursday). The panel learned that this is appreciated and works well. It thinks this is a very good initiative: it is key to interact on a regular basis, especially with a joint degree, with most staff simultaneously working at a "home" university and in the joint programme.

Learning environment, intake and study progress
Although the panel is conducting a limited programme assessment that does not involve institution-wide issues (like quality assurance and quality culture aspects, the staff policy pursued by the institution(s), services and facilities, and alignment with the institution's strategy), it had, beforehand and during the site visit, some discussions regarding the low intake of students. It believes there are ways to increase the intake without endangering the quality of the current programme. The programme management indicated that it is addressing this during the development dialogue.
The panel learned from the self-evaluation report that the study success levels are very good. This is an indication that although the programme has a diverse intake (international students, both EU and non-EU, and students from universities of applied sciences), it succeeds in getting the students to the same high quality level. There is an Admission Committee, consisting of three staff members from the three universities. After being enrolled at WUR, students are also registered at RUG and UT. If students have a deficiency because of a different educational background, it can be dealt with in the first year, and students will make an individual programme with the study advisor.

Considerations
In conclusion, although there is room for improvement, the panel thinks Wetsus offers a great and inspiring learning environment with excellent facilities for its master students. It was pleased with the balanced structure and design of the first-year curriculum. It was particularly pleased with the last two courses of the first year: the *Computational Methods* course and the cooperative project (Business Case), which combines all of the previously learnt skills to design a solution for a relevant real-world issue. It learned that all the ILOs are reflected in the curriculum, but how the learning goals of the different courses relate to the ILOs should be made clear.

The second year consists of a thesis/research project of 40 EC and an internship of 15 EC. The panel was very impressed by the attention paid to the final research project/thesis, in terms of both quantity (40 EC) and quality (supervision). It was also impressed by the professional connections of the programme and the large number of internship possibilities available, although it considers an internship of 15 EC too short.

The three universities (WUR, RUG and TU) are jointly responsible for the curriculum, with a course load division of 44% (WUR), 36% (RUG) and 20% (TU), respectively. The panel established that the teaching staff are experts in scientific and professional respects. They are also enthusiastic and committed, and students appreciate their accessibility. The panel thinks it is key for the staff to interact on a regular basis, especially with a joint degree with most staff working simultaneously at a "home" university and in the joint programme.

Finally, the good study success rates indicate, that the programme succeeds in getting all students (from different educational and cultural backgrounds) at the same academic level.

Conclusion
Master's programme Water Technology: the panel assesses Standard 2 as 'good'.

Standard 3: Student assessment
The programme has an adequate system of student assessment in place.

Findings

General assessment policy
In 2017, WUR, the leading partner in the joint degree, renewed its vision on education along with its education assessment policy. This assessment policy defines why and how WUR assesses and how the roles and responsibilities are distributed. Its goal is to generalise the assessment rules and policies and make them transparent for both lecturers and students. In this policy, the intended learning outcomes (ILOs) of the degree programmes form the starting point of the assessment. They are described for every programme and matched to the Dublin descriptors. In every programme WUR tries to create a clear relation between the ILOs and the learning objectives of the courses, the teaching and learning activities, and the assessment.

The panel finds that WUR has a good general assessment policy and clear assessment plan. In general, the WT programme follows this general assessment policy and applies different assessment methods – written and oral examinations, practical training with individual and group assignments, project reports and presentations – that match the different types of teaching methods and are aligned to the different ILOs. For example, ILOs at a higher cognitive level (like the application of advanced knowledge or judgement and design) are mainly assessed by written exams with open questions, oral exams, reports or oral presentations. It is clear from the self-evaluation report that all ILOs are tested. There is a course-dependent assessment strategy, which is written down in a clear and transparent online course guide. The course guide also provides information on how the final grades are determined. As mentioned under Standard 2, the panel would advise the staff and programme management to design a matrix that aligns the ILOs to the courses' learning objectives. This should also be made clear in the study guide.

Typical of the master's programme WT is that a lot of attention is being paid to the assessment or evaluation of feedback and reflection. Every course offers the option for students to review their work. Some lecturers invite students to join a feedback session or final meeting, while others send written feedback or make a personal appointment. The panel was charmed by this focus on feedback and reflection.

Examining Board
The master's programme WT has its own Examining Board (EB) with representatives of the three universities involved and a secretary. It meets three times a year to evaluate the assessment of the courses. It also checks the quality of the assessments by looking at assessment criteria, specification tables, exam questions and answering models. Ongoing individual cases (such as requests for exemptions, additional re-sits, etc.) are handled in or outside the three meetings, for instance through email. Finally, it performs a regular random check on the thesis assessments.

The study programme approval (SPA) is also part of the EB's responsibility. The study advisor checks every individual study programme of the WT students and evaluates whether it complies with the programme's ILOs, before it is submitted to the EB, along with his/her recommendation.

It is clear to the panel that the EB knows its legal duties and responsibilities, is pro-active and in control. The panel also applauds the intentions of the EB to advise the programme management to develop more independent assessment procedures and forms suitable for this specific master's programme. This will help to calibrate the differences between the involved universities, which still occur now and then (in e.g. assessment and grading).
Thesis and internship assessment
The second year of the WT programme is devoted to the thesis and the internship. The thesis is assessed on the basis of research competences, the thesis report, an oral presentation and a final discussion. Prior to the start of the project, students are informed about the criteria and weighting

of the final assessment. These criteria can also be found on the thesis assessment form and rubric. Both are made transparent to the students. Halfway through the process, students need to reflect on their performance and progress (on the basis of their own research proposal) at an evaluation meeting. Here they get feedback from the two supervisors involved in the thesis process. At the end, a thesis committee, consisting of at least one examiner from one of the involved universities, assesses the overall quality of the thesis. The thesis report is assessed by at least two examiners.

The panel thinks the overall thesis assessment is thorough. What it found striking was the rather low weighting of the oral presentation and discussion (together 10%) as well as the weighting range, between 30% and 60%, of both the thesis report and the internship on the general assessment forms. It feels that the important skill and ILO of communication deserves a greater weighting. Furthermore, it advises the thesis committee and programme management to assess the performance of the student half-way through the thesis process. This could also be done after a few weeks on the basis of a go/no go recommendation.

The panel studied several theses and their accompanying assessment forms. It learned that the theses supervised by UT, WUR and RUG examiners go through a plagiarism check (ephorus). It advises making it clear on the assessment forms that the thesis has been checked for plagiarism. Overall, the panel found the feedback on the forms to be clear and well-founded, and in general it agreed with the marks given. It thus feels the assessment of the theses is valid. However, it did notice some differences between the marks given by the examiners of the different universities involved. It learned during the site visit that although there is just one general assessment form and rubric (from WUR), there are still differences in the assessment methods and views on grading (and even the weighting of the different parts), depending on the assessment strategy and culture of the different universities. According to the panel, this can be resolved by organizing calibration sessions and digitalizing the assessment forms. This calibration could occur naturally if there are supervisors/examiners involved from at least two different universities. The EB of the WT programme told the panel it wants to take more control and advise the management to make its own assessment forms and rubrics suited for this programme. The panel can only agree with this.

The final year of the programme also includes an internship. The internship is supervised by a university examiner and a supervisor at the internship placement. It is assessed by three products: a written report, a self-reflection on the internship, and an oral presentation. An assessment form and rubric are available and provided to both examiner and supervisor and the student at the start of the internship. The panel would advise to make a different assessment form for the internship. The panel finds the procedures of the internship to be sound and transparent. However, although it applauds the attention that is paid to self-reflection, it doubts that a self-reflection report can be objectively graded – even with a rubric.

Considerations

The panel finds that WUR has a good general assessment policy to which the WT assessment policy in general is aligned. The programme applies different assessment methods that are matched to the different learning outcomes. All learning outcomes are tested. There is a distinction between the assessment methods used and the complexity of the learning outcomes. The course guide contains an assessment strategy for each course. The panel judges the assessments to be clear and transparent, although it would advise the staff and programme management to design a matrix that aligns the ILOs to the courses' learning objectives..

The panel believes that the EB knows its legal duties and responsibilities, is pro-active and in control. Some assessment procedures could benefit from more calibration and could be professionalized and simplified by, for instance, digitalizing the assessment forms.

According to the panel, the overall thesis and internship assessments and procedures are thorough, although it has a few comments concerning the assessment forms. It would advise the programme

to make its own assessment forms and rubrics and to make a difference between the forms of the thesis and internship.

Conclusion
Master's programme Water Technology: the panel assesses Standard 3 as 'satisfactory'.

Standard 4: Achieved learning outcomes
The programme demonstrates that the intended learning outcomes are achieved.

Findings
To review the achieved ILOs, the panel studied several documents and 15 theses and spoke with alumni. Overall, it agreed with the grading and considered the theses to be of a proper scientific level. They clearly reflected a path of learning and critical thinking. Generally speaking, the literature reviews were good, there were clear research questions, proper research following the methodology, and clear results. The theses were nicely drafted, and it is evident that in general much attention was paid to the final layout and presentation. The theses reflect the ILOs. All of the studied theses are final products of an academic master's degree programme and showed that the students had achieved the ILOs.

The panel also spoke at length with staff, students and alumni about the connection to the professional field. During the programme, students are thoroughly prepared for a position in the professional field. This is achieved, for example, by incorporating real-world topics (offered by external commissioners or companies) in projects that students work on, and of course the experience that students gain during the internship.

Alumni of the programme are very satisfied and feel very well prepared for jobs especially inside but also outside academia. Because of the embedding of the programme in Wetsus, students are taught in an environment close to their future work field. The self-evaluation report shows that 29% of all graduates started a PhD research project.

The panel was very impressed by the excellent connections of the programme to the professional field. The ILOs clearly match the requirements of the work field. The job perspectives of this programme are clearly very good: most graduates who do not go into PhD research end up in jobs in industry, public utilities, SME companies, consultancy agencies and governments both inside (52%) and outside the Netherlands. What impressed the panel was that international students also find a position quickly after graduation, many of them at a Dutch company.

Concerning standard 4, the panel would like to give the programme management one recommendation: put more effort into creating an alumni community by, for instance, organising return days.

Considerations
To review the achieved ILOs, the panel studied several documents and 15 theses. Overall, it agreed with the grading and considered the theses to be of a proper scientific level. All of the studied theses are final products of an academic master's degree programme and showed that the students had achieved the ILOs. The panel spoke at length with staff, students and alumni about the connection to the professional field. It was very impressed by the excellent connections of the programme to the work field. During the programme, students are thoroughly prepared for a position in the professional field. Alumni of the programme are very satisfied and feel very well prepared for jobs, especially inside but also outside academia.

Conclusion

Master's programme Water Technology: the panel assesses Standard 4 as 'good'.

GENERAL CONCLUSION

According to the panel the master's programme *Water Technology* meets the standard and the NVAO criteria for re-accreditation. The panel was particularly impressed by the inspiring learning environment with excellent facilities and the excellent connection with the professional field.

Conclusion
The panel assesses the *master's programme Water Technology* as 'good'.

APPENDICES

APPENDIX 1: PROGRAMME OBJECTIVE AND PROFILE

Water is a defining component of our blue planet and is essential for all living organism. However, a great amount of our water is used for agricultural and industrial processes, causing a scarcity of suitable water sources by depletion and pollution. Not only do industry and agriculture experi- ence a scarcity of water as a required raw material, but they also face a scarcity of other raw materials (e.g. fossil fuels for the production of energy and nutrients for the production of fertilizers). The Water Technology master programme looks at sustainable water treatment technol- ogies in a broader perspective than only the purification of water for a certain purpose. Water Technology also focuses on the recovery of raw materials such as metals and nutrients from processing (waste) waters and the production of sustainable energy.

Water Technology focuses on the worldwide attention currently being paid to the environment and sustainable issues. New technologies which prevent discharge of polluted water to the environment, may contribute to, amongst others, more biodiversity, a healthy soil and to less antibiotic resistance. By recycling metals and minerals in water streams, we prevent increasing environmental pollution and a further depletion of raw materials.

To meet these societal challenges, the Wetsus research institute has defined five main research areas aimed at developing breakthrough solutions:
- Sustainable water supply
- Waste water treatment and reuse
- New water sources
- Reuse and production of components and energy from water
- Detection of pathogens and micro/nano pollutants

These areas combined with the goal to develop new tech- nologies will encourage multidisciplinary research from a range of disciplines including membrane science, micro- biology, process engineering, electrochemistry and water physics.

The Water Technology master is strongly connected to the research areas of Wetsus, and research forms a central element of this master. The responsible universities, WUR, UT and RUG decided to embed the joint master at Wetsus from the start. The Wetsus organisational unit facilitates both the educational and the research part of the master.

The master focuses on (cross-) disciplinary scientific knowledge relevant to the research field of water process technology and includes applying engineering knowledge to the design and analysis of water processes.

In the context of water technology and related disciplines, the master combines scientific knowledge mainly from two domains – life sciences and physical sciences – with applications from chemical and bioprocess engineering.

Specifically in relation to water the master covers natural phenomena, the technological applications of biological systems, and the engineering principles required to carry out (bio) chemical processes. The Water Technology master is water process-oriented and its focus is on sustainable water technologies.

The Water Technology master aims to educate students to become design-oriented researchers with research as the focus area and design the means. They are able to develop, propagate and apply innovations and sustainable optimizations, and create new insights within the broader framework of the growing scarcity of raw materials (mainly water), energy and associated pollution. This framework forms the foundation for the master's intended learning outcomes, and distinguishes the programme from other (inter)national master programmes.

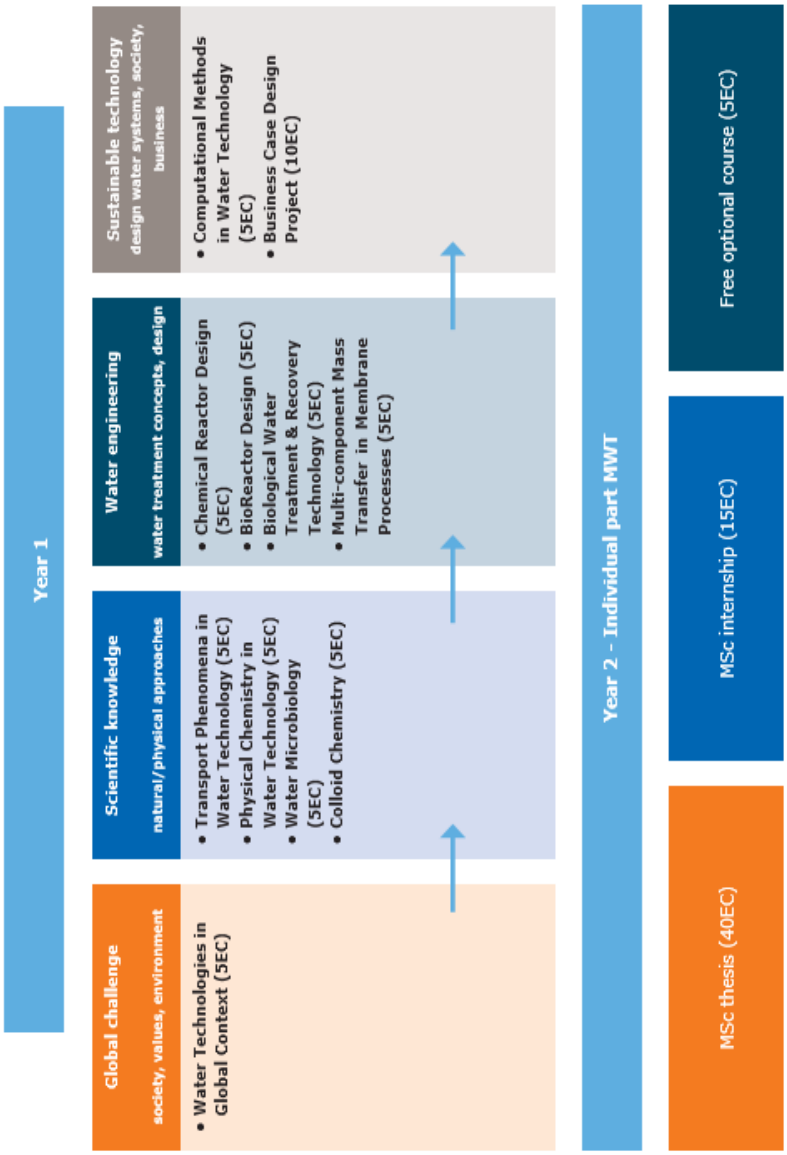
APPENDIX 2: INTENDED LEARNING OUTCOMES

In line with the 3TU Academic Competences, also called the Meijer's criteria, the final qualifications have been defined for the Water Technology master's programme. The relation between the final qualifications of the 3TU Academic Competences and the Dublin Descriptors are given in the first column of the table.

Dublin descriptor		Learning outcomes Graduates
Knowledge and understanding (Discipline)	1	have demonstrated adequate scientific knowledge and understanding of water technology pertaining to the basic sub-areas of the process engineering programmes of biotechnology and chemical engineering;
	2	have the ability to extend their knowledge with the application of new and emerging technologies through study;
	3	have the ability to integrate knowledge of and handle complexity from the abovementioned disciplines;
Applying knowledge and understanding (Research & Design)	4	have advanced research skills in at least one sub-area of water technology: literature search, design and execution of experiments, interpretation of data, and computer simulation ;
	5	have the ability to independently acquire new knowledge through research;
	6	have demonstrated sufficient knowledge and understanding to independently design solutions to unfamiliar problems that needed to be solved using sustainable technology;
	7	can apply their knowledge and understanding when designing new or modified water treatment processes and related products, with the intention of creating value in accordance with predefined requirements and desires, and show their flexibility in dealing with un- certainties;
Making judgments (Intellectual skills)	8	have the ability to be critical and self-critical, to reflect constructively in discussions with others, and to form well-reasoned opinions;
Communication (Co-operating skills)	9	have demonstrated a sufficient sense of responsibility, communication and leadership skills to interact adequately and to work professionally and effectively with other (international) researchers and stakeholders in the interdisciplinary field of water technology;
Learning skills (Scientific approach)	10	have demonstrated a systematic approach characterized by the development and use of theories, models and coherent interpretations related to water technology and its sub-areas;
	11	have demonstrated a critical attitude and insight into the nature of water technology during the design, execution and analysis of experiments and the comparison of results and conclusions with existing knowledge and theories.
(Additional) (Context)	12	have demonstrated awareness of the different roles of professionals and the use of sustainable water technology in global society;
	13	are able to decide on their own role in society and integrate ethical and normative aspects in their scientific work;

(Seven competence areas according to Meijer's Criteria):
a) the domain of the fields of study involved (1,2,3,4,5,6,7)
b) the academic method of thinking and doing (8,9,10,11)
c) the context of practicing science (12,13)

APPENDIX 3: OVERVIEW OF THE CURRICULUM



APPENDIX 4: PROGRAMME OF THE SITE VISIT

20 September 2018		
11.00	13.30	Arrival of panel, lunch, internal meeting and documentation review
13.30	14.25	Interview with management (including programme committee)
14.25	14.30	Mini break
14.30	15.15	Students
15.15	15.30	Break
15.30	16.15	Teaching staff
16.15	16.20	Mini Break
16.20	17.05	Examining Board and Study Adviser(s)
17.05	17.45	Alumni
17.45	18.15	Internal deliberation panel, short recap day 1

21 September 2018		
8.45	9.45	Arrival of panel, internal meeting and documentation review
9.45	10.30	Deliberations panel
10.30	11.15	Final interview with management
11.15	13.00	Deliberations panel and formulating preliminary findings and conclusions + Lunch
13.00	13.15	Feedback of preliminary findings and conclusions

APPENDIX 5: THESES AND DOCUMENTS STUDIED BY THE PANEL

Prior to the site visit, the panel studied fifteen theses of the master's programme Water Technology. Information on the selected theses is available from QANU upon request.

During the site visit, the panel studied, among other things, the following documents (partly as hard copies, partly via the institute's electronic learning environment):

- internship guidelines
- Wetsus Personal Development Programme for PhD students

Courses:

XWT-34305	Multi-component mass transfer in membrane processes (UT)
XWT-30305	Biological Waste Water Treatment & recovery technology (WUR)
XWT-24305	Physical Chemistry in Water Technology (RUG)